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TABLE OF CONTENTS

VOLUME 62 JULY 1955 NUMBER 1

ORIGINAL ARTICLES

PAGE

Vocal Rehabilitation of Paralytic Dysphonia 1
Godfrey E. Arnold, M.D., New York

Acoustic Neurofibroma 18
Francis O'N. Morris, M.D., Whittier, Calif.

The Treatment of the Hump in Rhinoplasty 28
Alan L. Rowland, M.D., San Diego, Calif.

Role of Depressor Septi Nasi Muscle in Rhinoplasty 37
Gustave B. Fred, M.D., Boston

The Treatment of Purulent Otogenic Meningitis 42
Shiro Nakamura, M.D.; Denzo Toyomura, M.D., and Nobuosa Iida, M.D., Tokyo, Japan

Voice Physiology and the Emergence of New Vocal Styles 50
Esti D. Freud, Ph.D., New York

Ménière's Disease, Cochlear Type 59
Maurice Saltzman, M.D., Philadelphia

Complications of Postnasal Packing for Epistaxis 62
Arthur J. Kuhn, M.D., and O. Erik Hallberg, M.D., Rochester, Minn.

AUDIOLOGY SECTION

Recruitment, Pitch Tests, and Speech-Tone Hearing Discrepancies 66
J. Donald Harris, Ph.D.; Henry L. Haines, M.D., and Cecil K. Myers, B.S., New London, Conn.

CASE REPORTS

Recurrent Suppurative Mediastinitis Eighteen Years After the Ingestion of a Foreign Body 71
Richard Thomas Barton, M.D., Beverly Hills, Calif.

Bronchial Granular-Cell Myoblastoma 81
James H. Ramsey, M.D., Hagerstown, Md.

Epistaxis 84
Max Kulvin, M.D., Coral Gables, Fla.

Recurrent Swelling of the Tongue Due to Cirsoid Aneurysm (Angioma) 90
Herschel Burston, M.D., Los Angeles

CLINICAL NOTES, NEW INSTRUMENTS AND TECHNIQUES

Retractors for Radical Antrum or Transantral Ethmosphenoidectomy Operations 93
Norman E. Johnson, M.D., New Britain, Conn.

PROGRESS IN OTOLARYNGOLOGY

Functional Examination of Hearing 94
Alfred Lewy, M.D.; Sherman L. Shapiro, M.D., and Norman Leshin, M.D., Chicago

REGULAR DEPARTMENTS

Abstracts from Current Literature 111

Directory of Otolaryngological Societies 117

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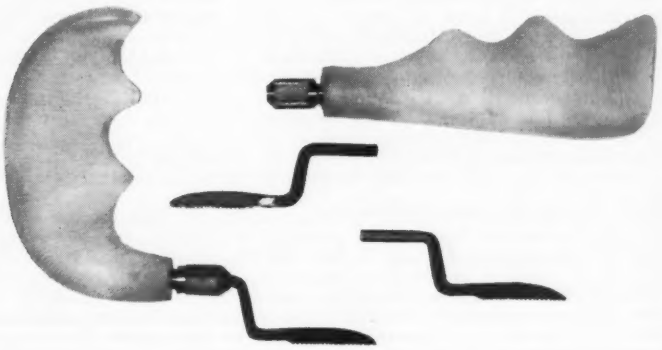

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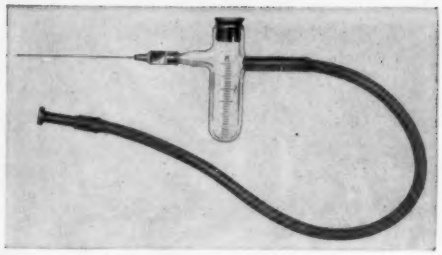

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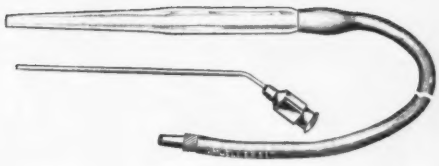

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Vocal Rehabilitation of Paralytic Dysphonia

I. Cartilage Injection into a Paralyzed Vocal Cord

GODFREY E. ARNOLD, M.D., New York

FUNCTIONAL EFFECTS OF LARYNGEAL PARALYSIS

The larynx serves several functions: (1) sphincter action for the protective or reflectory occlusion of the airways; this is needed for deglutition, expectoration, defecation, and physical exertion; (2) respiratory abduction of the vocal cords for the opening of the airways during breathing; (3) phonatory adduction of the vocal cords for the intonation of voice (phonation). Hence, laryngeal paralysis may disturb each or all of these functions. The effects of paralytic disability naturally depend on the type of paralysis. As is well known, laryngeal paralysis may be unilateral or bilateral, partial or complete, and it may disturb abduction or adduction.

Abductor paralysis immobilizes the cord in the paramedian line. The resulting obstruction to respiration is moderate in paralysis of one cord, while bilateral paralysis causes severe dyspnea. Phonation, on the other hand, is but slightly disturbed because the paralyzed cord always remains in the position of phonation. Various surgical procedures for the relief of this paralytic respiratory obstruction were described and discussed by many authors: Gleitsmann (1910), Klestadt (1921), Amersbach (1922, 1932), Marschik (1922), A. Réthi (1922, 1923, 1927, 1928, 1932, 1933, 1934), Dahmann (1926), Albrecht (1929), Wittmaack (1930), Kahler (1931), Hoover (1932), Loré (1936), Luchsinger (1937), Krainz (1939), King, (1939, 1953), Strother (1940), Kelly (1941, 1947), Rieben (1942), Meurman (1943), Woodman (1946, 1948, 1949, 1952, 1953), Clerf (1947), Lewy (1948), Loebell (1949), Thornell (1949), Čurkovič and Horvatsky (1953), Scheer (1953), Pearlman and Killian (1953), and so on. Their aim is the laterofixation of one cord in an abducted position so that the glottis remains permanently widened.

This permanent increase of the glottal space naturally presents an unsolved dilemma. Since these operations can never restore the physiologic vocal cord movements of abduction and adduction, they merely substitute various degrees of constant abduction for the previous paralytic adduction. It follows that respiration improves in direct proportion to the glottal enlargement. Phonation, however, must obviously deteriorate at the same rate. True, many patients are reported to retain or regain a "good" or "serviceable" voice. So long as exact assays of vocal function are not undertaken with such patients, these relative and subjective descriptions might have a different significance to different observers.

If the voice is good after laterofixation of one vocal cord, it is the result of a new mechanism of phonation. Since the normal process of phonation between the approximated cords is no longer possible after the surgical fixation of a paralyzed cord in the abducted position, a different type of phonatory occlu-

From the Department of Otolaryngology (John F. Daly, M.D., Chairman) of New York University Post-Graduate Medical School and the ENO Laboratories (George K. Higgins, M.D., Ph.D., Director) of the New York Eye and Ear Infirmary.

sion has been developed. Some patients achieve this spontaneously. Others need the guidance of voice therapy. As has been observed in cases of traumatic laryngeal injury, almost any part of the laryngeal introitus may develop the sphincter mechanism of a pseudoglottis. The vicarious glottal chink may be seen between both ventricular folds, between one cord and the opposite ventricular fold, between a ventricular fold and the opposite aryepiglottic fold, or between the descended epiglottis and the arytenoids. In the last case it is helpful to elevate the cocainized epiglottis with a probe in order to visualize this type of vicarious phonation.

Adductor paralysis produces the opposite results. While respiration remains normal, the voice is partly or completely lost because the glottis cannot be closed for normal voice production. Again, some patients learn to compensate for this deficiency by developing the familiar crossing over the midline of the healthy cord. Others institute some vicarious mechanisms, such as the "false cord" voice (dysphonia ventricularis). As a rule, these vicarious compensations are not very satisfactory and the patients remain hoarse. A detailed analysis of the various causes and types of this paralytic dysphonia has been discussed in a previous book (1948).

Whenever the cause of the paralysis cannot be alleviated, phoniatric rehabilitation of the voice should first be attempted. As is well known, remarkable degrees of vocal improvement can be achieved by systematic and rational vocal exercises. The established methods of physical therapy (galvanic, faradic, and isochronic currents, harmonic massage, etc.) offer further help (Arnold, 1941, 1948, 1949). In some cases, however, it is no longer possible to improve the closure of the glottis for phonation. This may be due to advanced muscular atrophy of the paralyzed cord, physical weakness, poor health, advanced age, general psychomotor insufficiency, or psychoacoustic debility of auditory discrimination ("tone deafness"). These are the patients who do not improve in spite of expert and extensive voice therapy.

For their sake three types of surgical procedures were devised and performed with varying functional results: (1) nerve anastomosis, (2) mediofixation of the paralyzed cord, and (3) paraffin injection into the atrophic cord. The last two procedures attempted a mediofixation of the paralyzed cord and a restitution of its loss of substance. Hence, they represent the opposite of the procedures for the relief of respiratory obstruction, namely, the narrowing of the glottal chink, which is sometimes implied in the name, "reversed King operation." Contributions to this problem were made by Payr (1916), Schmerz (1919), Frazier (1930), A. Réthi (1933), Porta (1940), Meurman (1942, 1952), Seiffert (1943), Morrison (1948) and others.

INTRALARYNGEAL INJECTIONS OF THE PARALYZED CORD

In 1911 Bruenings reported an ingenious technique of injecting the paralyzed cord with hard paraffin (46C melting point). Under direct or indirect vision the plastic paraffin was introduced with a special syringe. The technique was simple, the postoperative course uneventful, the functional results were excellent, and subsequent observations failed to reveal untoward complications. Soon the method was widely accepted, as is evidenced by a large number of confirmative publications: Bruenings (1912, 1917, 1918), Kofler (1914), Zange (1916), Seiffert (1916), Neumayer (1921), O. Mayer (1922, 1930), Amersbach (1926, 1929), Sokolowsky (1931), Iglauer (1931), and others. It appeared that in the larynx paraffin was tolerated better than in other regions. Long observations of the patients so treated failed to show any unfavorable results (Bruenings, personal communication, 1939). At least no publication of late complications can be found in the literature. In 1947 the Swiss textbook by Barraud, Nager, Ruedi, Schlittler and Taillens mentions the paraffin injection as one of the standard treatments of laryngeal adductor paralysis.

Systematic appraisals of all vocal functions following this procedure were reported

by Schilling (1942) and Arnold (1947, 1948). Their system of graphic analysis of the voice before and after the operation supplemented the general impression of remarkable improvement. A few actors and singers could even resume some professional use of their trained voices.

In spite of these good clinical results, paraffin injections are now considered obsolete. Paraffin causes chronic foreign-body reactions, with the formation of granulation tissue (paraffinoma). When injected in other parts of the body, it failed to retain its place, or gave rise to embolism. This was attributed to the use of soft paraffin (42C melting point). Similarly, paraffin injections into the posterior pharyngeal wall for the improvement of velopharyngeal closure in cases of cleft palate were of no avail: the paraffin usually descended, sometimes even into the mediastinum.

Contrary to universal experience, Imre (1950) believes in "the absorption of paraffin" and claims that "the absorption of paraffin frequently necessitates a repetition of the (intralaryngeal) injections." In general, however, he had no scruples about paraffin, for as recently as 1952 he recommended retropharyngeal paraffin injections for the improvement of cleft-palate speech, although the worthless and even harmful results of this application had been recognized many years ago. Lately (1953) he reversed his rejection of intralaryngeal paraffin injections and recommends their further use.

EXPERIMENTS WITH NEW MATERIALS

Although the obsolete method of paraffin injections can no longer be advocated, the time-tested technique of the intralaryngeal injection with the Bruenings syringe had proved so advantageous that a search for a new injectable substance appeared desirable. Experiments were therefore begun in 1949 at the Institute for Experimental Surgery of New York University.

In theory it appeared most logical to try cartilage as a suitable material for intralaryngeal transplantation. Since cartilage is widely used by plastic surgeons, many questions relating to its viability and the reaction of the surrounding tissues could be answered by perusal of the literature on reconstructive surgery. Padgett's comprehensive volume gives a detailed documentation of all pertinent problems. It also shows some divergence of opinion regarding certain details of preparation, technique, results, or histologic interpretation of the various transplantation methods. Individual skill and variations of experimental procedure seem to account for some differences in such observations. Hence, it may not always be possible to explain why a particular method does not appear equally advantageous to all observers. The general conclusions, however, are well established and offer valuable guidance for a new approach.

A cartilage transplant may be fresh and living, or preserved and dead. Depending on the source, it may furthermore be autogenous (from the same individual), isogenous (from a relative), homogenous (from the same species), or heterogenous (from a different species). Another widely used transplantation material is bone in the same six classifications of state and source. Finally, one might consider artificial materials like plastics and alloys. It is possible that the newer materials do not have to be condemned as generally as in 1933, when Carter considered them incompatible with the laws of physiology and biology. Hoffman's favorable report on injections of Palavit (a methyl methacrylate preparation) into nasal defects shows the interest in this problem.

Much evidence is available concerning the suitability of cartilage transplants. According to Carter (1933), autogenous cartilage is never absorbed when properly implanted. Peer (1941, 1945, 1948) demonstrated that fresh autogenous cartilage is most desirable because it survives as living cartilage. Young cartilage transplanted before adulthood may even grow. Peer also stressed that the chances of complete survival are inversely proportional to the size of the cartilage particles, the smallest parts surviving best. He therefore used diced cartilage. Fresh homogenous transplants as a second choice may or

may not survive. Homogenous cartilage preserved in alcohol or aqueous thimerosal (Merthiolate) is less desirable because it is absorbed and replaced by fibrous tissue. Heterogenous cartilage in theory appears least suitable since its biological affinity to the proteins of the recipient must be limited. It may also be allergenic. When used in the preserved form it serves as well as any type of preserved cartilage. Stout (1933) recommended bovine scapular cartilage, preserved in formalin. He did not observe any allergic reactions. Salinger (1953) arrived at similar conclusions and noted the permanence of cartilage implants. Despite the loss of viability of the cartilage cells, the matrix appeared remarkably well preserved after many years. Even after absorption the replacing fibrous tissue was adequate for the maintenance of the desired contour.

The ultimate fate of bone transplants in the nose was studied by Carter (1932, 1933). While cartilage contains no blood vessels and is nourished by the intercellular circulation, the survival of bone depends on its penetration by new capillaries. Osteogenesis then proceeds from the transplant itself and from denuded bone in its intimate vicinity. Further growth is regulated by functional demands. Neither ovregrowth nor absorption was seen by Carter. Necrosis is always the result of infection or improper technique of transplantation. An important point is the removal of every trace of chemical agents used for the preparation of the operative field. Cottle, Quilty, and Buckingham (1953) advise against the use of benzalkonium (Zephiran) as a preservative. It causes liquefaction of the implant. They consider autogenous cancellous bone as the best graft material.

PREPARATION OF CARTILAGE PASTE

Our next problem was the reduction of cartilage (or bone) to small particles so that a paste could be prepared. Bone can be ground in special bone mills. Cartilage is easily broken up by filing with a rough file, by scraping with a knife, or by crunching in an electric grinder or mortar. From the surgical standpoint the procedure must be rapid, simple, efficient, and aseptic. Bacteriologic tests showed that our simple method of scraping the cartilage with a knife was perfectly safe.

These cartilage shavings then had to be mixed with a suitable vehicle in order to obtain an injectible paste. At first we thought that procaine-penicillin-oil would be ideal, since it offered a lubricating oily menstruum, prolonged local anesthesia, and local bacteriostasis. The mixing of the cartilage particles with a few drops of the penicillin-oil in a porcelain mortar quickly yielded a paste of desirable viscosity. Other substances, as gelatin, plasma, isotonic saline solution, etc., serve just as well. The ultimate choice will depend on the tissue reaction to these vehicles.

After many trials the following procedure was established. We used these four types of cartilage: (1) human septum cartilage preserved in formalin; (2) human septum cartilage preserved in thimerosal; (3) fresh rabbit rib cartilage, and (4) fresh dog rib cartilage.

Under sterile conditions the cartilage was cleaned of perichondrium and cut into small particles by scraping with a sharp knife. These shavings were then ground in a porcelain mortar. The brittle formalin cartilage offered the advantage of easiest grinding since it was quickly pulverized to a fine powder, even without previous cutting. However, formalin is not tolerated by living tissue. It has to be removed by sufficient washing for a few days.

Subsequently, a sufficient amount of procaine penicillin G in sesame oil (Monocillin, Schenley) was added and mixed in the mortar until a firm uniform paste resulted. With a small metal spatula this cartilage paste was then filled into an old fashioned Record syringe which had been adapted for this purpose. Its detachable head was replaced by a new brass head with a large opening that fitted exactly into the filling tube of the standard Bruenings paraffin syringe. After our special "loading syringe" was filled, it was connected to the filling tube of the paraffin syringe, and the cartilage paste was transferred to the latter.

TOLERANCE OF THE LARYNGEAL INJECTION

Although many clinical observations of paraffin injections into the human larynx have demonstrated that this procedure is well tolerated immediately after the opera-

tion as well as for many subsequent years, no histological studies on the intralaryngeal changes were reported. The effects of the cartilage injection into the paralyzed larynx were therefore studied on several dogs. Since these experiments required the preliminary interruption of the laryngeal nerves, additional observations were made on the course and the effects of laryngeal paralysis. All experiments and operations were performed with pentobarbital (Nembutal) anesthesia.

Dog 1.—Interruption of the right recurrent nerve on Jan. 25, 1950: Laryngoscopy shows both cords in the intermediate position of relaxation with normal respiratory movements around this line. Neck incision and exposure of the right recurrent nerve. Immediately, the laryngoscopist reports paralysis of the right vocal cord in paramedian position. The left cord now shows increased respiratory movements as if to compensate for the paralytic narrowing of the glottis.

Faradic stimulation at various distances of the secondary coil. One electrode was attached to the right sternothyroid muscle; the other was applied to various structures. 1. Stimulation of right recurrent nerve: distance "5" or more gives no reaction; at distance "4.5" the paralyzed right cord begins to show regular clonic movements of adduction; at distance "3.5" strong clonic contractions; at distance "3" very strong adductions of both cords. 2. Stimulation of extrinsic muscles produced strong clonic contractions of muscles touched by the active electrode. The laryngoscopist observed clonic vertical movements of the entire larynx with some narrowing of the glottis. 3. Clamping of right recurrent nerve at distal end of exposure produced a few strong clonic contractions of the right cord; application of a second clamp at the proximal end of the exposure gave the same result; cutting the nerve between the two clamps gave no reaction. 4. Faradic stimulation of the lower central stump of the right recurrent nerve showed nothing; stimulation of the upper peripheral end produced strong clonic movements of the right cord as long as the current flowed. 5. Excision of the exposed lower stump of the right recurrent nerve showed nothing; excision of the upper stump produced a few strong clonic contractions of the right cord. Surgical closure of the wound, sterile dressing, penicillin.

Postoperative course: Feb. 1, 1950, the wound had healed p. p.; the dog looks happy and lively, but does not bark at all, no signs of dyspnea. Feb. 8, 1950, the dog is in perfect health and barks with a highpitched, weak, breathy, and hoarse voice, which has all characteristics of the human paralytic dysphonia due to acute laryngeal paralysis. The animal keeper says: "The dog was a tenor, now he is a eunuch." Laryngoscopy on March 15, 1950: The right tonsil is red, swollen, and prominent. The right vocal cord is immobilized in paramedian position; it looks straight, not bowing and not atrophic; the right arytenoid is in normal position. The dog always barks with high, thin, weak, hoarse, and diplophonic voice (paralytic dysphonia).

Interruption of the right superior laryngeal nerve on April 5, 1950 (10 weeks after the interruption of the right inferior laryngeal nerve): Laryngoscopy shows the right cord immobilized in paramedian position, not bowing, not atrophic; right arytenoid in normal position. The external branch of the right superior laryngeal nerve is exposed above and behind the upper end of the sternothyroid muscle, which it undermines to enter the cricothyroid muscle. During the excision of the exposed length of the nerve, the right cricothyroid muscle shows several clonic contractions before it relaxes visibly. Surgical closure of the wound. Laryngoscopy now shows the right cord in intermediate position, and the right arytenoid has fallen behind the left one; the left cord crosses the midline when the dog gasps while awakening.

Postoperative course: On April 12, 1950, the right tonsil is red, swollen, and prominent. Laryngoscopy: Both cords are white but slightly congested. The right cord is immobilized in intermediate position; the left cord crosses, and the right arytenoid hangs behind (posteriorly) the left one. The voice is low, weak, breathy, and very hoarse, definitely worse than before. "The eunuch became a bum," says the animal keeper. April 26, 1950, the dog appears healthy, lively, and barks with a very weak, low, and very hoarse voice. Laryngoscopy: Right cord in intermediate position; it looks thinner than the normal left cord (beginning atrophy).

Injection of cartilage paste (human septum cartilage, preserved in formalin, washed for a few minutes) into right cord on May 16, 1950 (15 weeks after first and 5 weeks after second nerve interruption): Laryngoscopy shows the right cord in intermediate position; it is slightly atrophic without much bowing; the left arytenoid crosses in front of the right arytenoid; the glottis is incompletely closed. Injection of 0.75 cc. of cartilage paste laterally of right vocal process until the right cord is pushed to the midline. The paste spreads into the midportion of the cord and causes a prolapse of the right ventricle. The glottis is now well closed. At the end of the procedure the right tonsil is red, swollen, and prominent.

Postoperative course: The dog was well and lively, but does not bark. May 16, 1950: No signs of illness. The voice is still very hoarse. Laryngoscopy: No tonsillitis, no dyspnea. The right cord is swollen, edematous, and bulges over the midline.

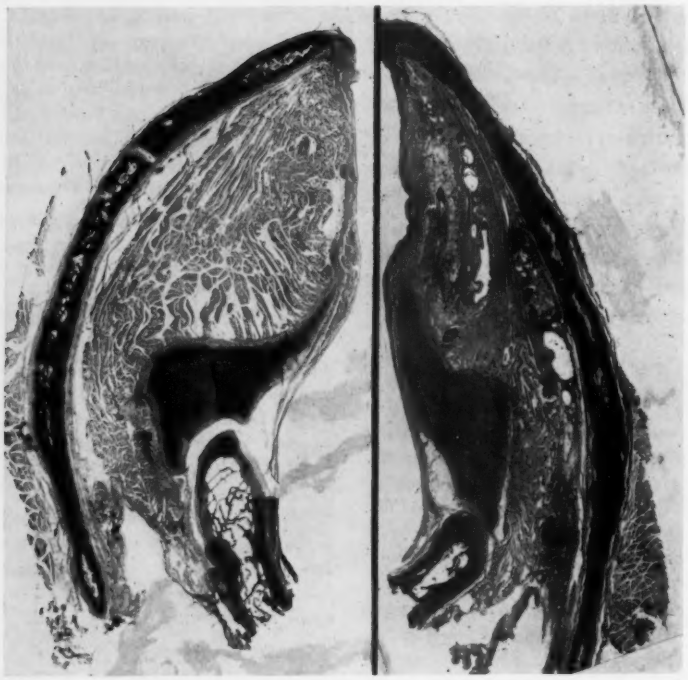


Fig. 1.—Dog. Laryngeal paralysis right side corrected by injection of formalin-fixed cartilage. Paralytic atrophy and inflammatory fibrosis on right side. The cartilage particles are visible as dark patches near the thyroid wing. Since the larynx was cut in two halves for study, this mounting was made of two photographs.

The right ventricular fold is red and swollen. The left cord is slightly swollen, so that the glottis is narrow but permits easy breathing.

May 24, 1950: The dog coughed for a few days and barked less. No dyspnea. The right side of the neck is swollen. Laryngoscopy shows bilateral tonsillitis. The right arytenoid is swollen, red, and edematous; the right pyriform sinus is flattened; the right ventricular fold is much swollen and covers the right vocal cord; the left ventricular fold is slightly swollen and partly covers the left cord, which is little congested; the glottis is narrow but allows sufficient breathing posteriorly. Impression: Interstitial laryngitis due to the injected formalin. Penicillin for a week. May 31, 1950: Good general condition and disappearance of external swelling. No cough, no dyspnea. The voice is hoarse but much louder than before.

June 7, 1950: Perfect condition. The voice is strong, low, and slightly hoarse. Laryngoscopy shows bilateral tonsillitis, and the left side of the larynx normal. The right cord is in the midline and is completely straight, smooth, white, and not swollen. The glottis is well closed. June 28, 1950: Perfect condition. Frequent barking with loud, high, almost clear voice. Laryngoscopy: No tonsillitis. The right cord is immobilized in the midline and looks straight, white, smooth, and normally full. Perfect closure of glottis. The right arytenoid is immobilized in normal position of phonation and does not sag forward or backward. Both cuneiform cartilages move symmetrically during forced respiration so that the laryngeal entrance can be well closed. July 20, 1950: Perfect condition. The voice is almost normal. Laryngoscopy: No tonsillitis. Right cord in paramedian (!) position; otherwise normal appearance; glottis well closed.

Dissection on July 21, 1950 (six months after first, three and one-half months after second nerve interruption, and two and one-half months after cartilage injection): The skin and subcutaneous tissue of the neck shows little scar formation. No residual signs of the perichondritic inflammation. The right cricothyroid muscle is completely atrophic. Typical removal of the larynx with the extrinsic muscles. It is cut sagitally in two halves and fixed in Bouin's solution.

Histological report (Dr. Higgins): Inspection of the microscopic sections made from the regions of the right and the left vocal cords shows an evident atrophy of the muscles on the right side. The fibers are still prominent, but the muscle masses appear

Fig. 2.—Dog. Formalin cartilage. The reaction produced by the injected formalin-fixed cartilage is chiefly fibrous at this stage. Note the persisting leucocytes, and "oil spaces," and the remnants of cartilage, some of which has been absorbed.

to be roughly one-third the size of those on the left. The picture of this paralytic atrophy following the interruption of the laryngeal nerves is somewhat distorted by the injected mass in the region of the right vocal cord. This occupies an area approximately 4 mm. in the muscle fibers (Fig. 1). The chief constituent is dense fibrous tissue, often surrounding and apparently strangling individual muscle fibers. Spaces, usually lined by evident, even prominent, flattened cells, are numerous. In a few of these, giant cells can still be identified (Fig. 2). As the center of the mass is approached, an active foreign-body reaction remains, with giant cells and fibroblasts being the predominant features. There is only slight round-cell infiltration remaining and practically no newly formed capillaries present in this area (Fig. 3).

Interpretation: The clear spaces are, without doubt, due to the presence of oil, and some areas show these spaces with very little additional fibrosis. Other areas show a marked fibrosis with destruction of the muscle in the area, probably the result of an inflammatory reaction with necrosis from the chemical (formalin) in the cartilage. Encroachment upon muscle is not evident in the other injected specimens.

GENERAL TOLERANCE OF THE CARTILAGE PASTE

The tolerance of the various cartilage preparations was studied on several rabbits. Typical findings are summarized in the following excerpts from the protocols. In order to ascertain the influence of heterogenous preserved cartilage, an experiment was done with fresh autogenous rib cartilage, the most advantageous transplantation material.

Rabbit 3.—Injection of autogenous rib cartilage on July 28, 1950: Extirpation of partly ossified cartilage. Surgical closure. Typical preparation of the cartilage-penicillin paste. Injection of 1 cc. of this paste into left quadriceps femoris muscle; 2 cc. penicillin I. M. Aug. 2, 1950: No signs of infection. The implantation remained palpable for four months as a soft, small, bean-shaped nodule. It did not disturb the animal in any way.

Dissection on Nov. 24, 1950: The injected muscle does not show any signs of gross foreign-body reaction. The implantation has no capsule and still contains small cartilage particles, though distinctly less than in Rabbit 1. Dissection and Bouin fixation.

Fig. 3.—Dog. Formalin cartilage. Periphery of the lesion, which is composed chiefly of scar tissue and the paralyzed atrophic muscle fibers.

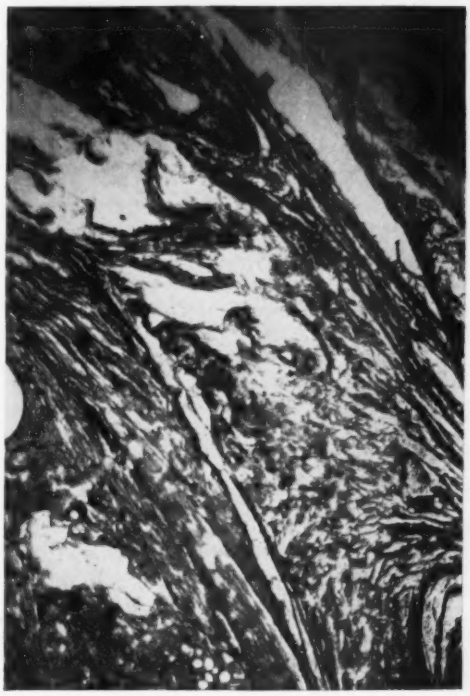


Fig. 4.—Rabbit. Intramuscular injection of autogenous fresh cartilage. Oil spaces surrounded by some collagen fibers and fibrocytes.

Histologic report (Dr. Higgins): The injected area remains fairly discrete and localized. There is no active inflammatory reaction, the lesion consisting of oil spaces with a small amount of collagen fibers and fibrocytes (Fig. 4). The cartilage has been fragmented so that the minute pieces remaining are enclosed in a giant cell syncytium, which in places has probably completely absorbed the cartilage matrix.

Interpretation: Most of the foreign-body reaction appears to be due to the oil. The cartilage is broken up and the fragments are surrounded by macrophages which form the syncytium. The more intense inflammatory process appears to be on the decline, and the reaction probably will result in a moderate or small amount of fibrosis with complete absorption of the cartilage, but this prediction cannot be determined with certainty.

TOLERANCE OF PRESERVED CARTILAGE

Another series of experiments was concerned with the tolerance for, and the behavior of, heterogenous preserved cartilage, the least advantageous transplantation material.

RABBIT 1.—Cartilage implantations: 1 cc. of human septum cartilage paste (thimerosal preservation) was injected in different muscles of both hindlegs on the following dates: Nov. 9, 1949, March 8, 1950; April 19, May 3, May 16, and May 24, 1950. An additional injection of human septum cartilage, preserved in formalin, was done on May 16, 1950. The cartilage implantations were left in the living muscle for 29, 12, 6, 4, 2 (thimerosal), 2 (formalin), and 1 week, respectively, i. e., from seven months to 1 week. During this time the rabbits enjoyed perfect health and were not at all disturbed by the infiltrations of their leg muscles. The implantations remained palpable as firm, nonmovable, beanshaped nodes, and did not change their positions.

Dissection on May 31, 1950: The skin and subcutaneous tissues of the injected areas appear normal. The injected muscles show some spread of the cartilage particles along the perimuscular septa. No signs of inflammation or hemorrhage. The muscles show slight edema and waxy pallor around the implanations. These still contain the firm cartilage paste which looks dirty gray in the oldest injections,

Fig. 5.—Rabbit. Formalin cartilage two weeks after injection. Most of the inflammatory reaction has disappeared. Some leucocytic exudate is evident, but it is not prominent. The outstanding feature is the excellent preservation of the cartilagenous matrix and the cells. Some masses of cartilage are in direct contact with the muscle fibers without evident reaction of either tissue.

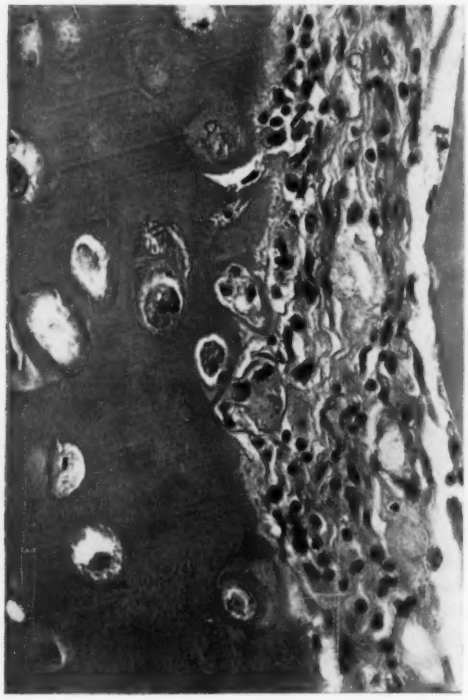


Fig. 6.—Rabbit. Intramuscular injection of thimerosal cartilage. After seven months the proliferative phase of the reaction is becoming dominant. The cartilage remains well preserved and becomes enclosed by connective tissue fibers.

and yellow-white in the most recent ones. A capsule is visible around the older implantations. All injected sites are dissected and fixed in Bouin's solution. All the other organs are normal and there is no metastasis, thrombosis, or embolism.

Histologic report (Dr. Higgins): The areas at the injection sites are quite discrete and localized, giving the impression that the mass has pushed the muscle fibers aside and has resulted in relatively little necrosis and proliferation. There is moderate cellular infiltration, round cells predominating over heterophiles at this stage. The fibrosis is becoming dense at the periphery, but no engulfment of muscle fibers can be found. The reaction is predominantly of foreign-body type with large and small oil spaces. Round-cell infiltration is prominent, and some heterophiles are still present. Giant cells have formed throughout, but many remain abortive (Fig. 5).

The cartilage stains acidophilic, is still more homogeneous than normal, since the lacunae are no longer as sharply defined and the contents stain similarly to the matrix. There appears to be active phagocytosis on the borders of the fragments by both large mononucleated cells and by heterophiles. Fragmentation of some pieces is evident. Absorption, however, takes place very slowly, and the cartilage is still evident in almost its original size seven months after injection. The inflammatory reaction gradually becomes more and more heterophilic as time elapses until superficially it has the appearance of an abscess (Fig. 6).

It is unfortunate that these experiments were not continued longer, for it appears that in the latest specimens there is developing a tolerance for the cartilage and that, even though cartilage lies in close proximity to muscle fibers, there is very little reaction (Figs. 7, 8).

Interpretation: It seems quite probable that thimerosal cartilage is quite resistant to phagocytosis and absorption and will remain in the tissues for many months. The inflammatory reaction is due in part to the oil. It is suggested that the inflammatory reaction is caused by the contained irritants (thimerosal) rather than by the cartilage itself, and that this reaction disappears with the diffusion of the irritant.

COMPARISON OF AUTOGENOUS AND HETEROGENOUS CARTILAGE

Dog 2.—Interruption of right superior and inferior laryngeal nerve on Dec. 21, 1950: Median

Fig. 7.—Rabbit. Thimerosal cartilage two weeks after intramuscular injection. The cartilage particles are in close association with the muscle fibers. No significant alteration from this contact is evident.

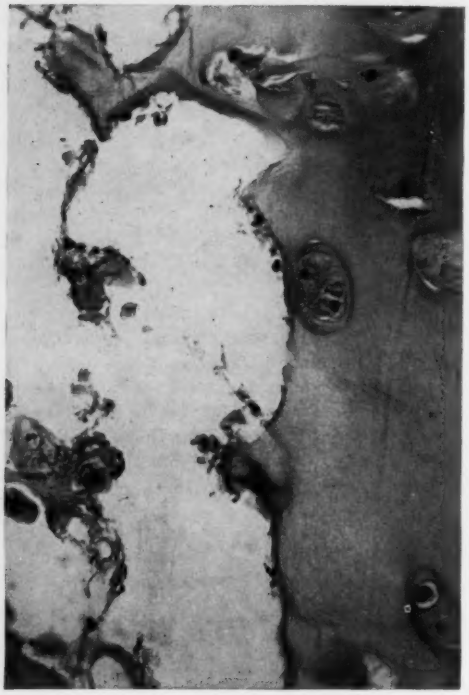


Fig. 8.—Rabbit. Formalin cartilage two weeks after injection. The edge of one cartilaginous mass is magnified to show the excellent preservation noted in Figure 5. The bordering cells suggest that removal of the cartilage is still in process, but is progressing at a very slow rate.

neck incision. Exposure of right recurrent nerve along trachea. Excision of a piece 1 in. (2.5 cm.) long. Exposure of the external branch of the right superior laryngeal nerve above and behind the upper end of the sternothyroid muscle. Excision of a piece 2 in. (5 cm.) long. Penicillin. Laryngoscopy: Right cord immobilized in paramedian position; some respiratory movements of the right arytenoid.

Postoperative course: Perfect condition; no dyspnea; frequent barking. Voice very hoarse, weak, breathy, high pitched. "The tenor became a falsetto," says the animal keeper. Laryngoscopy, Dec. 24, 1950: No tonsillitis. The right cord is in intermediate position. Same findings in January, 1951. Laryngoscopy on Feb. 8, 1951: Right cord in intermediate position; no atrophy. Voice very hoarse, almost aphonic.

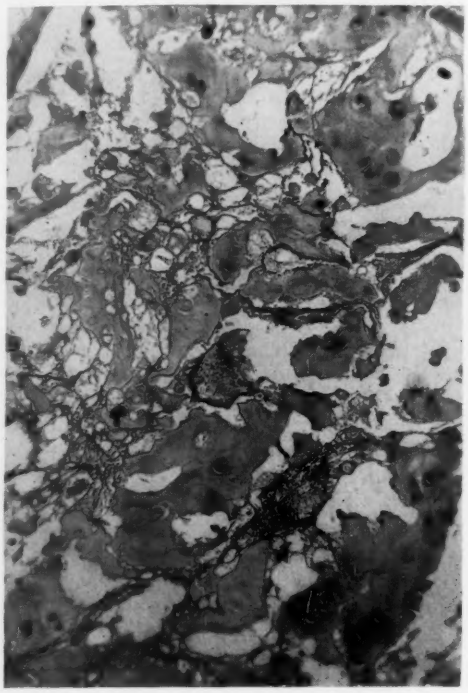
Injection of heterogenous preserved cartilage paste in right quadriceps femoris muscle on Feb. 8, 1951: Human septum cartilage, preserved in thimerosal and saline, typical grinding and mixing with penicillin G in sesame oil.

Postoperative course: Perfect tolerance of leg implantation. Frequent barking; voice high, weak, breathy, very hoarse. March 14, 1951, Laryngoscopy: Right cord in intermediate line, no bowing, no atrophy, glottis not closed, no crossing of left cord.

Injection of autogenous fresh rib cartilage paste into right vocal cord on March 14, 1951: Incision over right costal angle; excision of partly ossified rib cartilage; surgical closure. Typical grinding and mixing with penicillin G in sesame oil. Injection of 1 cc. cartilage paste into (1) lateral part of right cord, (2) base of right ventricle, and (3) in front of right arytenoid. The right cord is displaced to the midline and shows marked bulging of its medial border. No stridor, no dyspnea. Penicillin for one week.

Postoperative course: Perfect condition; no signs of reaction or malaise. No barking for a few days. March 21, 1951, frequent barking; voice is louder than before the injection, but more hoarse and rough. Laryngoscopy: Right tonsillitis. Right cord in median position, moderately red and swollen; glottis well closed; right arytenoid congested; no respiratory difficulty. April 24, 1951: Perfect condition; frequent barking. Voice much better than after the paralysis and after the injection; the pitch is a few tones lower, the volume quite loud, and the hoarse-

Fig. 9.—Dog. Thimerosal cartilage in leg muscle shows little heterophilic and more polyblastic reaction, with some cartilage absorption.



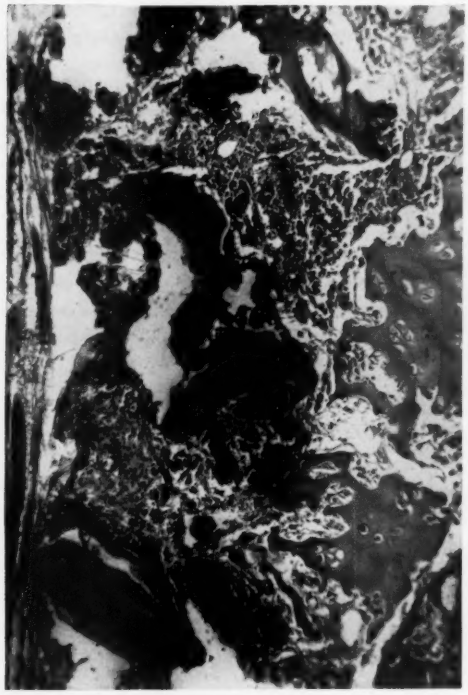


Fig. 10.—Dog. Laryngeal paralysis corrected by injection of autogenous fresh rib cartilage. The extensive calcification was preexistent. Moderate absorption can be seen on the surface and in the lacunae.

ness only mild. "Now the falsetto became a baritone," says the animal keeper. Laryngoscopy: No tonsillitis, no swellings or inflammation. The right cord is in paramedian (!) position, perfectly white, straight and round; glottis well closed. May 16, 1951: Perfect condition; voice loud, low, a little husky. Laryngoscopy: Right cord in paramedian position, white, straight, and round. June 5, 1951: Voice loud, low, almost clear. Laryngoscopy: Right cord in intermediary (!) position, white, straight, and firm; glottis well closed by crossing of left cord; no swellings or inflammation.

Dissection on June 5, 1951: (five and one-half months after nerve interruption, four months after injection of leg, and three months after injection of larynx): neck, chest, and leg appeared well healed. Right cricothyroid muscle completely atrophic. Typical removal of larynx. The injected muscle of the right leg still contains the cartilage paste and shows no signs of inflammation. All specimens in Zenker's solution.

Histologic report (Dr. Higgins): The thimerosal cartilage, placed in the leg muscle four months previously, shows an irritating reaction similar to that noted with the other prepared cartilages. Probably because of better washing with removal of most of the more intense irritants, the reaction is less heterophilic at this stage and more polyblastic. Evidence of cartilage absorption is present, but does not appear to be rapid (Fig. 9).

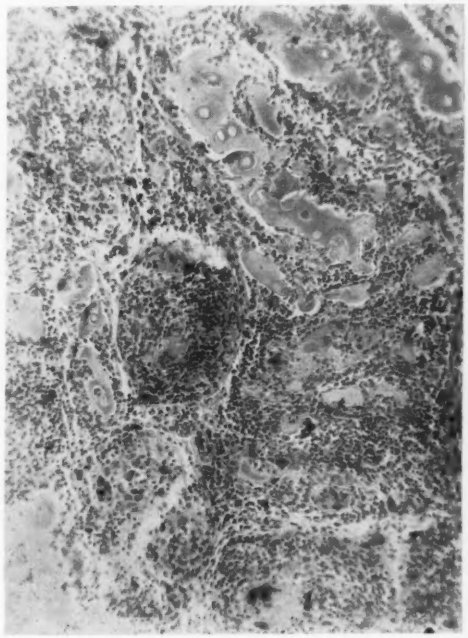
The autogenous fresh cartilage injected into the muscles of the larynx appear to be larger particles than those noted previously. Moreover considerable calcification of the cartilage is obvious, and was present at the time of injection. This probably accounts for the fact that there is less absorption than in the previous otherwise comparable specimen. Active absorption, both on the surface and through the enlarged lacunae, appears to be in progress (Fig. 10).

INFLUENCE OF PENICILLIN-OIL

Since part of the postoperative irritation must be attributed to the suspension of the cartilage particles in a penicillin-oil vehicle, the same experiments were repeated on rabbits with use of saline as a suspension medium.

Rabbit 5.—Injection of heterogenous preserved cartilage (thimerosal) on Oct. 2, 1953: Typical grinding of the washed cartilage and mixing with

Fig. 11.—Rabbit. Intramuscular injection of heterogenous formalin cartilage in saline suspension without penicillin and oil. Beginning absorption of the preserved cartilage.



saline. No postoperative complications or infections were noted.

Course: The rabbit remained healthy, and no infiltrations could be palpated when a second injection of heterogenous preserved cartilage (formalin) was given on April 27, 1954. This, too, was tolerated well until the animal was dissected on May 27, 1954. Macroscopically, the first implantation could not be detected. The second injection was grossly visible as fine white points without any surrounding inflammation.

Histologic report (Dr. Higgins): Finely divided particles of cartilage injected into striated muscle

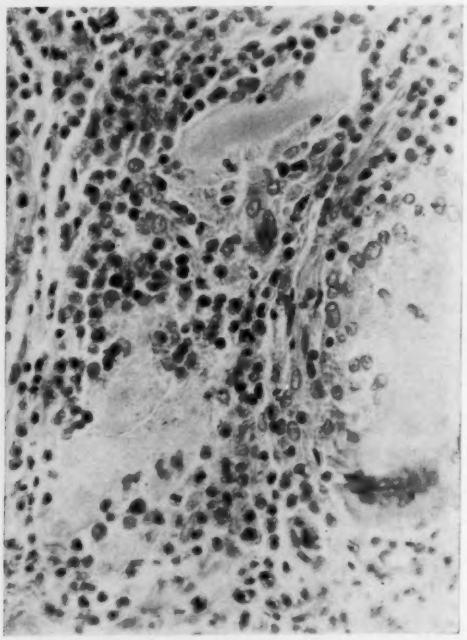


Fig. 12.—Rabbit. Heterophilic infiltration. Foreign-body reaction, and "moth-eaten" appearance of the formalin cartilage undergoing absorption.

one month previously. The cartilage is still intact but the cells within the lacunae are indistinct and cellular details have disappeared (Fig. 11). The tissue reaction shows a heterophilic reaction which might be considered approaching an abscess by their number; however, significant tissue necrosis does not occur. In addition, there is a rather prominent foreign-body reaction consisting of a macrophage syncytium with isolated typical foreign-body giant cells. Most often these macrophagic cells are in intimate contact with the cartilage but sometimes the polymorphonuclear cells are intimately associated. Both appear to attack the margins of the cartilage but the former appear to be chiefly responsible for the "moth-eaten" appearance of the edges. In some areas beginning calcification may be demonstrated by the basophilic staining which is developing (Fig. 12).

The picture presented is most compatible with that suggested in more advanced lesions, namely, that there is gradual absorption of the cartilage with a scarring at the site of the injection.

The muscle from the region of a comparable injection eight months previously was removed and examined carefully by gross study without finding the site of inoculation. Numerous sections were prepared, but examination of all failed to reveal the lesion. It seems more probable that the site, after the cartilage had absorbed and the inflammation subsided, was too minute to be located, than that no scarring had occurred or that the tissues had returned to normal.

COMMENT

The experiments on dogs demonstrated the effects of unilateral interruption of the two laryngeal nerves. The observations agree with modern concepts of the neurophysiology of the larynx. Their detailed discussion will follow in another paper.

Next we observed the clinical course of intracordal cartilage injections. Dog 1 was injected with a paste made of heterogenous cartilage preserved in formalin. Because of the insufficient washing, the remaining formalin caused diffuse laryngeal inflammation with the clinical signs of perichondritis. This subsided promptly with antibiotic therapy, and the further course was uneventful. Functionally, the injection was successful inasmuch as it completely restored the voice which previously was lost because of the laryngeal paralysis. Dog 2 received fresh autogenous rib cartilage and failed to show any clinical signs of complications. The mild postoperative reaction was similar to that observed in humans after intralaryngeal paraffin injections. Hence it must be attributed to the slight surgical trauma of the injection itself. Again, the voice was remarkably improved for the remaining three months of observation. One interesting difference was the more rapid disappearance of the postoperative swelling of the injected cord in Dog 2. Consequently, it returned to a more abducted position in the paramedian line because the injection was not sufficient to retain it permanently in the midline. This

did not disturb the balance of intralaryngeal compensation, and the voice remained greatly improved. In passing it may also be noted that these dogs always developed an acute tonsillitis on the same side of the intracordal injections. It seems that in dogs the tonsil is a regional lymphatic station of the larynx.

The tissue reaction to the injected cartilage was studied in several rabbits by injecting various types of cartilage paste into their leg muscles. Clinically, there were no signs of any discomfort or disease. Since each rabbit received several injections at varying intervals, we obtained a series of specimens of increasing age. These demonstrate the course of the pathologic reactions with the passage of time. Fresh autogenous cartilage (Rabbit 3) produced little inflammatory reaction, but seemed to be quickly absorbed. Preserved heterogenous cartilage, on the other hand, caused marked local inflammation, while it was more resistant to phagocytosis and absorption. This is surprising in view of the experience of plastic surgeons, who found that autogenous cartilage survived much better than any type of preserved and heterogenous cartilage. This contradiction is partly explained by our method of suspending the cartilage particles in penicillin-oil, partly by the insufficient removal of the preservatives. It may also be that the autogenous cartilage used here died before or during the preparation for injection.

A comparison of heterogenous and autogenous cartilage injected into the same animal was possible with Dog 3. The injection of heterogenous thimerosal cartilage was observed for four months. It showed round-cell inflammation and some absorption. Autogenous fresh cartilage three months after injection demonstrated less absorption than the preserved cartilage. However, active phagocytosis and erosion were noticeable. Consequently, this experiment was in better agreement with general experience.

With regard to the inflammatory changes, at least four types of tissue reaction have to be distinguished: (1) the trauma of the injection; (2) the acute irritation by the chemical preservatives (formalin, thimerosal), (3) the chronic reaction to the suspending menstruum (penicillin in sesame oil), and (4) the foreign-body reaction to the cartilage.

The surgical trauma of the injection consists in slight laceration and displacement of the muscle fibers by the injected paste which penetrates between their septa. Intralaryngeal injections in humans always were followed by a moderate swelling and redness of the injected area. It usually subsided within a week. In order to minimize this surgical trauma, the quantity of the injected material should be small, not more than 0.5 cc. for a vocal cord. Hence, it should be highly concentrated, with a firm and thick consistency, so that only a minimal space will be occupied by any absorbable vehicle. Otherwise, the previous experiences with intralaryngeal injections remain valid; for instance, the advice to inject laterally between the thyroid cartilage and the bulk of the vocal cord, and not into the medial part of the cord itself.

As to the chemical preservatives introduced with the cartilage, they can be avoided altogether if autogenous cartilage is used. In the case of preserved cartilage they have to be removed by sufficient washing in saline solution for several days, with daily changes of the solution. Among the advantages of chemical preservation it is interesting to note that preserved cartilage seems to resist the lytic action of the leucocytes, especially if fixed in thimerosal. There also was no actual necrosis of the surrounding tissues. The isolated influence of formalin could be seen in the last experiment.

The suspending penicillin-oil appeared to be responsible for a great part of the foreign-body reaction. Oil spaces, surrounded by round and giant cells, were evident in all specimens so treated. From this we learned that our first idea of using this antibiotic as a lubricating vehicle remains questionable. Another reason for caution is the increasing number of allergic complications. Even malignant changes have been attributed to the injected oils. Rather, one should use saline or gelatin as a suspending medium. Experiments with such suspensions are in progress. The last rabbit so treated actually showed the ab-

sence of the oil reaction. In any case, the vehicle should be just sufficient to hold the cartilage or bone particles together and make them injectable with the Bruenings syringe.

Concerning the cartilage fragments, one knows that cartilage is well tolerated by the tissues. A certain amount of extravasated fluids is even necessary for the nourishment of the cartilage substance, if it is to survive, in the case of fresh cartilage. Under the conditions of our experiments, the intimate contact of the cartilage with muscle for many months did not appear to produce evident pressure changes. The shredding of the cartilage into small flakes failed to influence the results adversely. This reminds one of Peer's statement that the smallest particles of live cartilage survive best, apparently because they are most easily reached by the nourishing body fluids. On the other hand, small particles of preserved cartilage are more quickly absorbed than large pieces, obviously because small particles offer an immensely increased surface to the eroding action of macrophages.

CONCLUSION

As is well known, laryngeal paralysis may prevent abduction or adduction of the paralyzed cord. The respiratory distress due to permanent and bilateral median stenosis is successively corrected by the established operations of laterofixation of one vocal cord. Adductor paralysis, on the other hand, causes the vocal disability of paralytic dysphonia. In many cases, the voice can be considerably or even completely restored by the conservative methods of phoniatric vocal reeducation. Whenever unfavorable local or general conditions preclude this intralaryngeal compensation, the surgical narrowing of the glottis by mediofixation of the affected cord may be desirable. Among the various procedures previously recommended for this purpose, the intralaryngeal injection of paraffin (Bruenings) gave excellent functional results. From the pathologic standpoint, however, paraffin can no longer be advocated.

In order to retain the time-tested technique of intralaryngeal injection with the Bruenings syringe, an effort was made to replace the obsolete paraffin by a substance with greater tissue affinity. Cartilage was first considered because it has proved its value in plastic surgery. Experiments were therefore undertaken with the aim of solving the problems of obtaining, preserving, preparing, and injecting a suitable cartilage preparation. It was found that cartilage can easily be shaved and ground to small particles which can then be mixed with a harmless vehicle to yield an injectable paste.

Such pastes were made by mixing cartilage crumbs of various types (autogenous, heterogenous, fresh, and preserved) with penicillin-oil. The pastes were then injected into the leg muscles of rabbits, and the specimens were recovered after varying periods of time. The histologic study of the specimens gave information on the reaction of the injected tissues. The reaction differed with the various pastes injected.

Unilateral laryngeal paralysis was then induced in dogs by resecting their two laryngeal nerves on one side. This produced marked hoarseness of their bark. After the onset of paralytic atrophy, the bowing vocal cords were injected with cartilage paste. The procedure was well tolerated by the animals and restored their voices for the remaining time of observation. Subsequently, the larynxes were dissected for further histologic studies which supplemented the findings on the rabbits.

SUMMARY

For many years Bruenings advocated his intralaryngeal injection of paraffin for the vocal rehabilitation of patients with unilateral laryngeal adductor paralysis. Although the functional results were excellent, paraffin can no longer be advocated. Experiments were undertaken in order to find a better substance for the same type of intracordal injection. It was found that cartilage can be ground and mixed with a suspending medium to provide an injectable paste. Such pastes were made of various types of cartilage and injected into the leg muscles of rabbits and into the previously paralyzed vocal cords of dogs. The clinical course and the patho-

logic findings of the injected specimens are reported.

Dr. John F. Daly sponsored most of these experiments; Dr. William C. von Glahn prepared most of the histological slides; Dr. George K. Higgins furnished special histologic preparations, the pathologic evaluation of the slides, and the microphotographs; Prof. Dr. Helmut Loebell (Münster, Germany) donated a Bruenings syringe; Dr. Lyndon Peer gave valuable advice; Dr. Walter Petryshyn took color films of some of the experiments; Dr. Roy T. Shults assisted with the animal experiments, and the Wenner-Gren Foundation aided a research program, part of which is reported in this paper.

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Acoustic Neurofibroma

The Relationship of X-Ray Findings to the Otological Diagnosis

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Of the wide variety of symptoms which patients present to the otologist, deafness and tinnitus are the commonest. Unfortunately, the earliest symptoms of an eighth-nerve tumor are usually these same symptoms. It is only when the patient has let the disease progress to a more advanced stage before presenting himself to the physician that one finds additional evidence to aid in making the diagnosis. Neurofibromas are notably slow-growing tumors and initially give rise to relatively mild symptoms. These early symptoms are frequently ignored by the patient or improperly evaluated by the physician. As otologists we are often the first to see the majority of these patients either by patient choice or by physician referral. This is a rather heavy responsibility when one realizes that acoustic neurofibromas comprise approximately 8% of all brain tumors.[1]

It is the purpose of this paper to emphasize the fact that x-ray evidence may be absent even in advanced cases of acoustic neurofibroma. The diagnosis of this tumor should not depend on confirmatory x-ray evidence. The diagnosis, particularly in the early stages, is dependent on a very careful evaluation of symptoms and the keen observation of signs. These facts should be kept in mind whenever the possibility of an eighth-nerve tumor presents itself.

In 1917 Harvey Cushing, in his classical monograph, published the results of the first comprehensive study of these tumors with definition of their essential diagnostic features.[2] Frequently we may fail to identify such a tumor because it does not fit into the syndrome he described or because it fails to show erosive bone changes on x-ray examination. The symptoms as summarized from Cushing's treatise occur in the following order:

1. Auditory and labyrinthine disturbances
2. Cephalalgia
3. Incoordination and instability of cerebellar origin
4. Involvement of adjacent cranial nerves
5. Indications of increased intracranial pressure
6. Dysarthria and dysphagia
7. Cerebellar crisis

Revilla,[3] in a clinical study of 160 cases, found that only 31% of the cases followed the chronological order described by Cushing. The other 69% of cases presented symptoms and signs at variance to this order. The variation in the appearance of the signs and symptoms depends upon the sequence in which the tissue structures surrounding the tumor become involved. This, in turn, is dependent on the site of the origin of the tumor and upon the rate and direction of tumor growth. Epstein [4] observed that when the tumor growth is principally within the auditory canal the petrous tip becomes decalcified and enlargement of the internal auditory meatus occurs. Obviously this may be accompanied by a minimal number of the classical signs and symptoms. When the major growth is outside the canal, x-ray signs may be absent. In the latter situation, as the tumor growth progresses, signs of involvement of the adjacent cranial nerves, the cerebellum, and the medulla may occur resulting from pressure, torsion, or inclusion. This gives rise to a striking clinical picture.

Submitted for publication Feb. 14, 1955.

Presented as a candidate's thesis in partial fulfillment of the requirements for membership in the American Laryngological, Rhinological and Otological Society, Inc.

Camp and Cilley [5] have demonstrated the existence of a normal variation between the diameters of the two internal auditory meatuses in the same skull. In 125 cases this variation in diameter was frequently 1 or 2 mm. and in some cases 3 or 4 mm. This is considerable variation when one realizes that the maximal diameter was found to be 11 mm., the minimal diameter 2.5 mm., and the average diameter 5.23 mm. Differences in shape and differences in depth (as great as 5 mm.) between the two sides of the same skull may also be considered normal. To show the abnormalities of the internal acoustic meatuses that may occur with eighth-nerve tumors, many radiologists consider that the Towne position gives the one most valuable x-ray view. In this view the petrous ridge is thrown free of superimposed structures and its superior-posterior surface may be well visualized.[6]

As the tumor growth progresses increased intracranial pressure usually occurs, resulting from obstruction of the fourth ventricle. X-ray evidence of this is most commonly manifest on plain films as changes in the sella turcica. These changes include straightening of the posterior clinoid, demineralization or actual erosion of the clinoids, and, occasionally, enlargement of the sella turcica itself.

If the x-ray study is negative, attention is frequently misdirected toward other possible diagnoses. This may be partially justified by the high incidence of positive x-ray findings reported by some authors. Lysholm [7] has reported an incidence of 90%, and Hodes, Pendergrass, and Young [8] in a study of 70 cases found the incidence to be 80%. However, the finding of specific x-ray evidence as reported in different studies is variable. According to a recent article by Greenwald and Whitsett,[9] a study of 36 proved cases revealed only a 58% accuracy of diagnosis on the basis of x-ray findings.

Acoustic neurofibroma may occur as a part of multiple neurofibromatosis, as in von Recklinghausen's disease. However, in this paper we will concern ourselves only with the neurofibroma that arises from the acoustic nerve. This tumor is usually unilateral but it may be bilateral. It is most frequently found arising from the short vestibular portion of the eight nerve but may arise from the cochlear division. It is of interest to note that Hardy and Crowe [10] reported six asymptomatic acoustic neurofibromas found when they were doing serial sections of the temporal bone in 250 cases. Each tumor was small, was within the auditory canal, and involved the vestibular portion of the nerve in four cases and the cochlear portion in the other two cases.

In the majority of cases acoustic neurofibromas become manifest about the fourth decade of life, although Mark and Sweet [11] reported a case without the stigma of von Recklinghausen's disease in a child of 8 years. About 60% of cases occur in women.*

It is now generally agreed that the tumor is a growth of the nerve sheath and not of the nerve fiber, i. e., a neurofibroma rather than a neuroma. Microscopically it is a densely fibrous tumor, the fibers appearing to grow in whorls and swirls. Occasionally these tumors may be vascular or cystic or may show evidence of fatty degeneration.†

The early diagnosis of acoustic neurofibroma depends on an accurate evaluation of the initial symptoms and signs. These symptoms and signs are those referable to involvement of the acoustic nerve and are usually followed by trigeminal signs, headaches, nystagmus, and cerebellar ataxia. Although acoustic symptoms are the first to appear in 75% of patients, trigeminal changes and cephalalgia account for the other 25% of initial symptoms.‡ Occasionally the mild initial symptoms, although they progress in severity, may be overshadowed by the predominance of a symptom, such as facial pain or headache, which in itself is not suggestive of the presence of a neurofibroma. It is logical that a patient with any of the aforementioned symptoms would consult an otorhinolaryngologist. Ferrell [15] reported discovering two cases of acoustic neurofibroma during rou-

* References 2, 3, and 12.

† References 2 and 13.

‡ References 12, 14, and 15.

tine refractions by the presence of papilledema. However, in each of these cases acoustic symptoms were present. Otologists must assume the responsibility of recognizing additional neurological signs in cases of unilateral hearing loss which may be due to acoustic neurofibromas.

In Edwards and Paterson's [12] series of 157 proved cases of neurofibroma, 98% presented abolished or impaired vestibular responses and 99% presented total or partial deafness on the side of the tumor. In Revilla's [3] series of 160 proved cases all the patients showed both auditory and labyrinthine disturbances. The perceptive hearing loss develops gradually and progresses slowly and steadily. An audiometric curve typical of a perceptive type of hearing loss may not occur early in the disease. Instead one may find either a reduction for the low tones with near normal acuity for high tones or a concentric narrowing of hearing acuity. Later on in the disease pressure atrophy invariably produces an absolute perceptive hearing loss. Occasionally changes may occur in the eighth nerve on the side opposite to the tumor mass. This is due to displacement of the medulla, resulting in tension and torsion of the contralateral eighth nerve.

In 1948, Dix, Hallpike, and Hood,[16] using a binaural loudness technique, demonstrated the presence of recruitment in 30 cases of unilateral cochlear dysfunction of the inner ear and its absence or incomplete presence in 20 cases of acoustic neurofibroma. Similar results were obtained by Fowler [17] utilizing binaural loudness balance for recruitment. Eby and Williams [18] show the presence of recruitment of loudness in Ménière's disease and its absence in tumors of the cerebellopontile angle. On the basis of these findings it is logical to conclude that recruitment is present only in lesions of the sensory receptor mechanism and not in lesions of the nerve. Thus we have a practical and diagnostically significant test for distinguishing between end-organ disease and retrolabyrinthine lesions.

Any variety of true subjective tinnitus may be found associated with acoustic neurofibroma. The tinnitus frequently persists even after complete loss of hearing has occurred on the side of the tumor. It is usually constant but may be fluctuating and intermittent. Tinnitus evaluation procedures are of no diagnostic value. Vertigo, when present, is usually transient and mild in degree due to the relatively slow growth of the tumor.

The vestibular responses are of tremendous importance. From these the correct diagnosis may be suspected before other identifying features appear. Classically the vestibular functions are abolished on the side of the tumor, with some impairment of the vertical canal on the opposite side.[19] However, in 42 cases reported by Brown and Love [20] the commonest vestibular response to caloric stimulation was a nonfunctioning labyrinth on the side of the tumor, with normal vertical and horizontal canals on the opposite side. The caloric testing may be done according to Bárány—using continuous douching with water—or according to the modified Kobrak test. The absence of past-pointing and the absence of shock susceptibility to stimulation on the involved side are two prominent features usually found with acoustic neurofibromas. When they are found during routine caloric testing they should cause the examiner to focus his attention on the possible presence of an eighth-nerve tumor.

Ménière's disease is rather commonly confused with the early stages of acoustic neurofibroma but it should present no real problem when we recall that attacks of whirling vertigo in Ménière's disease are paroxysmal, usually abrupt in onset, accompanied by nausea and vomiting, and of relatively short duration. The tinnitus of Ménière's disease commonly persists between attacks and frequently fluctuates in intensity. Although the perceptive hearing loss in this disease is progressive, it frequently fluctuates, and it usually occurs in both ears, with a tendency to be more severe in one ear.[21]

Headaches figure prominently in the symptomatology of acoustic neurofibroma. They usually appear shortly after the initial eighth-nerve symptoms but occasionally appear as

the first symptom of the disease. They may be frontal, occipital, or fronto-occipital. In addition to the headache one may find associated suboccipital and neck pains, which are aggravated by straining and neck extension. The headaches are described as intermittent in character and as varying from a dull discomfort to a sharp severe pain. They are frequently precipitated or intensified by sudden exertion or change in position. They usually occur at night or soon after arising in the morning.[14] Gradually they increase in frequency and severity. These headaches may be caused by elevated intracranial pressure but, because of their early appearance and the absence of associated papilledema, one would suspect the real cause to be tension on the nerves and on the brain coverings.[22]

Another of the prominent features in the symptomatology of acoustic neurofibroma which directs the patient to the otorhinolaryngologist is that of trigeminal nerve involvement. Involvement of this nerve causes pain, numbness, and/or paresthesias referable to the distribution of the nerve. The signs which may appear are loss or impairment of the corneal reflex, loss or impairment of facial sensation, and motor weakness, all on the side of the tumor. The corneal response is by far the most sensitive index of defective sensory function of the fifth cranial nerve. Revilla [3] reported that 56.6% of his 160 cases had trigeminal disturbances and of these 16% actually had pain typical of tic douloureux on the involved side. Facial pain is more commonly the result of other etiological factors, but its importance when associated with eighth-nerve symptoms should not be overlooked.

The remaining group of early signs and symptoms associated with the diagnosis of acoustic neurofibroma is that of the cerebellar signs. Incoordination of the limbs with disturbances of station and gait will be noted. Spontaneous nystagmus was present in over 90% of the cases in the different series reported in the literature reviewed by me. The nystagmus, with slow and quick components, is typical of that associated with disturbed vestibular function in contradistinction to the ocular type of nystagmus in which the movements are more nearly equal. The characteristic finding is a bilateral horizontal nystagmus which has its coarse, slow, and prominent component to the side of the tumor and the fine, rapid component to the uninvolved side. The direction of the nystagmus may readily be reversed by caloric stimulation. In those cases in which the examiner, using the unaided eye, may question the presence of nystagmus, ophthalmoscopic examination of the fundus may be used to detect the presence or absence of fine motion. Other evidence of cerebellar involvement may present itself as dysarthria, ataxia, hypotonia, and defective conjugate movements of the eyes.

As previously mentioned, with advanced tumor growth many of the cranial nerves as well as the brain stem may be involved. Function of these structures should be checked during the neurological survey. Involvement of the facial nerve usually results in spasm of weakness of the face on the side of the lesion and is readily explained by the close relationship this nerve bears to the eighth nerve. Cushing [2] in his series of cases noted that facial spasm was commoner than facial weakness and recalled how, in times past, it was usually attributed to Jacksonian epilepsy. Dysphagia caused by involvement of the 9th and 10th cranial nerves usually occurs only in advanced cases.

As the tumor becomes of sufficient size to compress the fourth ventricle, the resulting increase in intracranial pressure manifests itself through papilledema, diplopia, failing vision, anosmia, and impairment of consciousness. This impairment of consciousness may be suggested by an inability of the patient to give an accurate history. If it is more severe drowsiness is usually apparent.

Cerebrospinal fluid characteristically shows an increase in protein content.§ However, it might be wise at this point to inject a word of caution, as it is a well-known fact that sudden death may occur when spinal fluid

§ References 3 and 12.

pressure is reduced in the presence of subtentorial tumors.

When one considers how the presence of this tumor as a cause of hearing loss, vertigo, and tinnitus may be completely overshadowed by commoner aural conditions, it is easy to understand why the otologist may ascribe the patient's symptoms to a relatively benign condition. For this reason patients with this tumor frequently are not seen by neurosurgeons until the growth has reached an advanced stage. From the surgical point of view, early diagnosis, because of the smaller tumor size, greatly enhances the ease of removal of the tumor, with a correspondingly low mortality rate. Therefore we should remember that when cerebellar signs, headaches, or trigeminal sensory changes (especially loss of the corneal reflex) occur in association with unilateral deafness and diminished vestibular responses we have the cardinal diagnostic features of an acoustic neurofibroma.

In the following cases of proved acoustic neurofibroma several interesting features may be noted. In all of these patients x-rays failed to show any changes in the internal acoustic meatus. This is an important point. It is an asset to have x-ray evidence to support the diagnosis of acoustic neurofibroma, but the otologist should not be influenced by failure to demonstrate changes in the bone when the presence of such a tumor is suspected. Under these circumstances he should rely on clinical findings.

In this group of 10 cases, the first 9 will be summarized briefly.

REPORT OF CASES

CASE 1.—Sixty-year-old woman. Illness of six years' duration.

Complaints (in order of appearance)	Findings
Hearing loss, left	Papilledema, bilateral
Tinnitus, left	Staggering gait
Staggering gait	Nystagmus
Paresthesia of face, left	Hearing loss, left
Weakness of lip, left	Absent vestibular responses, left
Diplopia	Loss of corneal reflex, left
Loss of visual acuity	Numbness and weakness of face, left
Dysphagia	Atrophic trapezius, left
Dysarthria	
Occipital headaches	
Neck pain on extension	

CASE 2.—Forty-six-year-old woman. Illness of 12 years' duration

Complaints (in order of appearance)	Findings
Staggering gait	Nystagmus
Deafness, right	Facial weakness, right
Weakness of hand, right	Weakness of hand, right
Numbness of inside cheek, right	Deafness, right
Frontal headaches, right	Adiadokokinesis, right
Spasm of facial muscles, right	Dysmetria, right
Tinnitus, right	Absent vestibular responses, right
	Positive Rhomberg
	Tumor mass: 4 cm. in diameter

CASE 3.—Twenty-nine-year-old woman. Illness of three years' duration

Complaints (in order of appearance)	Findings
Headache	Deafness, right
Numbness of arm, right	Absent vestibular responses, right
Hearing loss	Hyperesthesia of mandibular area, right
Tinnitus	Tumor mass: 5 by 4 by 4 cm.
Vertigo	
Paresthesia of face, right	
Vomiting	

CASE 4.—Sixty-three-year-old woman. Illness of one year's duration.

Complaints (in order of appearance)	Findings
Headache	Papilledema, bilateral
Poor coordination	Facial paralysis, right
Weakness of legs	Dysarthria
Convulsive episodes	Hypotonia of legs
Hearing loss	Incoordination
Dysarthria	Spinal fluid protein, 112 mg/100 cc.
	Ventriculograms showed blockage in vicinity of fourth ventricle
	Tumor mass: 2.5 cm. in diameter

CASE 5.—Thirty-nine-year-old woman. Illness of two years' duration.

Complaints (in order of appearance)	Findings
Tinnitus, right	Hearing loss, right
Deafness, right	Absent vestibular responses, right
Facial twitching, right	Tumor mass: 1 by 1 by 0.5 cm.

CASE 6.—Fifty-year-old woman. Illness of three years' duration.

Complaints (in order of appearance)	Findings
Mild staggering	Deafness, left
Partial numbness of face, left	Abnormal gait
Paresthesia of face, left	Numbness of face and cornea, left
Tinnitus	Absent vestibular responses, left
Deafness	

CASE 7.—Forty-two-year-old man. Illness of unknown duration.

Complaints (order of appearance unknown)	Findings
Headaches	Papilledema, bilateral
Staggering	Numbness of face, right
Hearing loss	Loss of corneal reflex, right
Tinnitus	Weakness of face, right
Double vision	Diplopia
Numbness of face, right	Partial deafness, right
	Absent vestibular responses, right
	Positive cerebellar signs
	X-ray showed "Sella turcica attenuated"
	Tumor mass: 3.5 cm. in diameter

CASE 8.—Forty-three-year-old man. Illness of six years' duration.

Complaints (in order of appearance)	Findings
Deafness, right	Hearing loss, bilateral
Deafness, left	Papilledema, bilateral
Defective vision	Ventriculograms showing obstruction beyond third ventricle
Loss of vision	X-ray showed "Sella turcica deep and wide, consistent with increased intracranial pressure from any cause"
Headaches, frontal	Tumor mass: 5 by 3 by 2.5 cm.
Jerking of arm and leg, right	

CASE 9.—Thirty-seven-year-old woman. Illness of unknown duration.

Complaints (order of appearance unknown)	Findings
Deafness	Partial deafness, left
Tinnitus	Absent vestibular responses, left
Defective vision	Right pupil larger than left
Loss of equilibrium	Nystagmus
Nausea and vomiting	Paresis of sixth cranial nerve, left
	Hyperesthesia of face, tongue, and cornea, left
	Mild weakness of face, left
	Positive cerebellar signs
	X-ray showed "demineralized sella turcica"

In the first six cases no abnormalities of the internal acoustic meatus or of the skull were demonstrated by x-ray. In all of these cases the x-ray study included stereoroentgenograms of the skull and a projection in the Towne position. However, in each of these cases, surgical exploration based on clinical study led to discovery of a tumor mass arising from the eighth nerve which, after removal, was proved to be an acoustic neurofibroma. In Case 6 erosion of the internal auditory meatus was noted by direct observation at the time of surgical removal of the tumor. This was one and a half months after the x-ray study. It is apparent that the erosion either did not visualize on x-ray or fell within the normal limits of size and configuration for the internal acoustic meatus. This illustrates some of the difficulties facing the radiologist, and it is well that the otologist be cognizant and equally appreciative of the problem.

In Cases 7, 8, and 9 changes in the internal auditory meatus were not demonstrated by x-ray but changes in the sella turcica indicative of increased intracranial pressure were noted. These cases emphasize the fact that x-ray evidence of erosion of the internal acoustic meatus may be absent even in advanced tumor formation.

Case 10 will serve to demonstrate how one's attention may be directed away from the correct diagnosis of acoustic neurofibroma.

Case 10.—A 55-year-old woman who died suddenly the night before a scheduled cerebellopontile angle exploration.

Three and one-half years before death the patient had consulted an otologist, complaining of deafness and tinnitus. It was felt that these symptoms were associated with the presence of an acute otitis media. A myringotomy was performed but the symptoms persisted. One year later the patient consulted me complaining of occipital headaches, vertigo, deafness, tinnitus, nausea, and jerking of the eyes. Examination revealed marked hearing loss on the left, absent labyrinthine responses on the left, nystagmus, and a polyp in the left middle ear visualized through a perforated tympanic membrane. The polyp was removed. The pathological report was "necrotic tissue." X-ray study was recommended, and the referring physician was advised of the possibility of acoustic tumor formation. The x-ray study consisted of stereoroentgenograms and posteroanterior, lateral, Stenver's, and submentovertical views of the skull. No abnormalities were noted. On the basis of this negative x-ray report the referring physician treated the patient for hypertension and menopausal syndrome.

About six months later she was examined for a possible cerebellopontile angle tumor by the neurol-

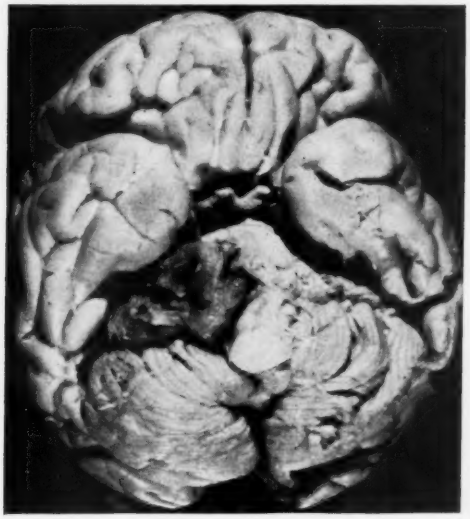

Fig. 1.—Photograph of the base of the brain showing size and location of tumor mass.

ogical department of a well-recognized midwestern clinic. It was felt that the patient's symptoms were the result of a local ear condition and that there was no evidence to justify exploration. At that time it

Fig. 2.—Photograph of the encapsulated tumor showing incorporation of the seventh and eighth cranial nerves in the tumor mass.

was reported that x-ray study showed mild cloudiness of the left mastoid process without cell destruction.

One month before death the patient was again referred to me for further consultation. At this time she was complaining of loss of vision in the left eye, deafness in the left ear, left occipital headaches, vertigo, and ataxia. Examination revealed bilateral papilledema, intact tympanic membranes, noncorrectable visual acuity of 20/50 in the left eye, nystagmus, loss of corneal sensitivity on the left, twitching of the left face, loss of hearing and loss of vestibular responses on the left, and ataxia. X-rays of the skull (stereoroentgenograms, left lateral, posteroanterior, Law's, and Mayer's views and oblique views of the orbits) were taken and compared with the previous films. The petrous pyramids appeared normal. The sella turcica was

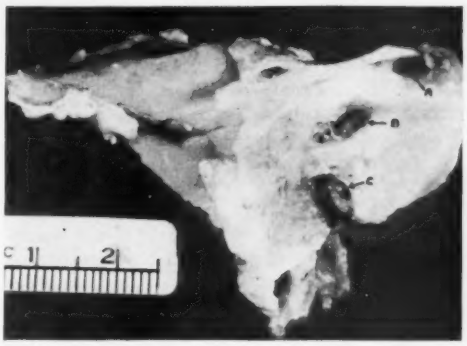

Fig. 3.—Photograph of a portion of the petrous bone viewed from the medial aspect of its posterosuperior surface. *A*, trigeminal notch; *B*, internal acoustic meatus; *C*, jugular notch.

reported normal in size and configuration but showed slight demineralization of the posterior clinoid process.

After neurosurgical consultation the patient was scheduled for the removal of a probable left acoustic neurofibroma. As previously mentioned, she died suddenly the day before the scheduled surgery. A postmortem examination was performed by a pathologist. The sudden death of this patient from other causes permitted the tumor mass to be photographed in situ. Figure 1 shows the relative size of the tumor, its location, and the deformity of the cerebellum and medulla produced by the tumor. Figure 2 is a close-up view of the tumor showing the incorporation of the seventh and eighth nerves in the encapsulated tumor mass. Figure 3 shows the petrous bone viewed from the medial aspect of its posterosuperior surface. The internal acoustic meatus measures 3 by 7.5 mm. This is within normal limits. This tumor was classified as a vascular acoustic neurofibroma.

SUMMARY

Since acoustic neurofibromas arise from the sheath of the acoustic nerve, the early signs and symptoms almost invariably include unilateral tinnitus, loss of hearing, and impairment of vestibular responses. The signs and symptoms that may accompany or follow these early manifestations and the order of their appearance depend upon the site of the origin of the tumor and upon the rate and direction of the tumor growth.

Early unilateral impairment of vestibular function is usually unnoticed by the patient, and partial loss of hearing and tinnitus are frequently ignored. However, progressive enlargement of the tumor produces more profound eighth-nerve changes which may be accompanied by headaches, involvement of adjacent cranial nerves, cerebellar disturbances, or evidence of increased intracranial pressure.

Since the early symptoms of an eighth-nerve tumor usually direct the patient to an otologist, he plays an important role in the establishment of an early diagnosis. The possible presence of an acoustic neurofibroma should be considered whenever a patient presents evidence of unilateral eighth-nerve changes, especially when these changes are accompanied by cerebellar signs, headaches, or trigeminal sensory disturbances.

Early diagnosis of acoustic neurofibroma simplifies surgical removal, minimizes the amount of adjacent cranial nerve damage, and reduces mortality. Unfortunately, in the majority of patients with eighth-nerve tumors surgical removal of the tumor is delayed for want of early diagnosis. The failure to obtain x-ray evidence of tumor formation should not influence the clinical diagnosis nor delay surgical intervention if such a procedure seems indicated by appropriate clinical findings.

117 S. Greenleaf Ave.

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CORRECTION

In the abstract of Dr. French Hansel's paper on "The Use of Staphyloccus Toxoid in Otolaryngolgy," read before the American Laryngological Association, which appeared in the January issue of the ARCHIVES (p. 119), the following statement did not correctly reflect Dr. Hansel's viewpoint as to dosage: "Best results are obtained by giving increasing doses of a high dilution up to the point where local reactions are observed." Dr. Hansel states that "a dosage established below that which causes an exacerbation of the symptoms is the amount which produces the optimum therapeutic effect. . . . The effective dosage should be approached from the very weak ineffective zone to the one which produces the most satisfactory results, thus avoiding the zone of reaction." If the patient's symptoms are aggravated, the dose should be reduced by at least half. If the symptoms are markedly increased or a reaction occurs, the dose should be dropped to one one-hundredth or even one one-thousandth.

The Treatment of the Hump in Rhinoplasty

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To a student of the literature on the art and the science of the rhinoplastic operation, the most startling fact is probably the amazing progress which has been made in this branch of surgery in a few short years. Little more than 30 years ago operations were being done by the legitimate, respected surgeons in the field which were shocking in their crudity, completely uncertain in their end-result, and extremely dangerous in their sequelae as to risk of infection or to sloughing, with its attendant, almost complete negation of result. It is no wonder, then, that until only 25 years ago the operation was done almost exclusively for restriction of major function or, by utilization of the French or Italian methods (both almost unchanged in the last century and a half), for flap replacement of actual, substantial loss of tissue of the nose.

A few historical notes will confirm these observations and at the same time shed certain light on the evolution of this procedure, especially as it bears on the long, humped nose, a type more frequently seen by the rhinoplastic surgeon than all others combined.

It was about 1930 before it was thought feasible to perform reconstructive nasal plastic surgery for the relief of obstructive symptoms or for a more pleasing cosmetic transformation of the nose.

Thus, as late as 1920, Gillies, one of the great pioneers in the field of plastic reparative surgery, devoted his entire book of 408 pages exclusively to traumatic injuries, adding at the very end of this work just a note bearing on the future possibilities of plastic repair in civil cases. He [1] states:

> The application of the methods described and discussed in the previous pages will, in the author's opinion, have considerable effect upon the possibilities of plastic surgery amongst the civil community. It may be also, that, apart from the much wider field of deformities which will be brought into the class in which successful restoration can be applied, the treatment of the disease itself, in addition to the deformity caused by the disease or injury, will be modified. Thus, when it is demonstrated that successful and cosmetic rhinoplasty is an operation that can be counted on with reasonable certainty, the early treatment of lupus may be modified in the direction of complete excision of the affected area regardless of the deformity so caused.

At that time the primary text on plastic surgery was that of Davis. Probably nothing can bring home more clearly to the present-day surgeon the amazing progress that has taken place in so few years in reconstructive surgery of the nose than the few indications cited below.

"To reduce the size of the nose," Davis states, "if the nose is too large, it may be reduced by removing sections of the skin and underlying tissues. When the nose is naturally large or has been increased in size by trauma, in addition to the skin, sections of the nasal and septal cartilages may have to be removed before any permanent result is obtained."

It will be seen from Figures 1 and 2 that the operation is external completely, that it must result in relatively marked mutilation of the nose, and that it would certainly not have been done for cosmetic improvement, to say nothing of its complete lack of consideration for the functional intranasal end-result.[2]

Received for publication, Nov. 12, 1954.

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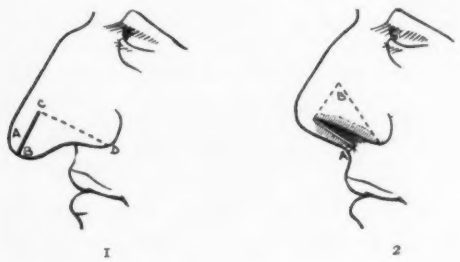
Fig. 1.—Dieffenbach's operation for reducing the size of the nose (Szymanowski) (1 and 2). The shaded area indicates the defect left after the excision of a vertical and horizontal segment of skin and subcutaneous tissue. A similar excision should be done on the other side of the nose, and the wounds then closed. (From Davis, J. S.: Plastic Surgery, New York, Blakiston Company, 1917.)

Davis then considers the removal of the hump.*

The bridge of the nose may also be very prominent, either naturally or following injury. This prominence may be reduced by trimming the bone and cartilage subcutaneously through an incision at the tip of the nose (Monks); by the submucous method of Roe, and others; or by the external method. There is practically no visible scarring following the first two methods, *but my own preference in these cases is for direct exposure through a midline, a lateral, or a transverse curved incision over the bridge, depending on conditions.* The soft parts are divided and retracted until the bone and cartilage are exposed, and the desired amount is removed from the bridge and from the sides. The soft parts are then closed and firm pressure is made over the site of operation.

* Davis, J. S.: Reference 2, pp. 484-486.

Fig. 2.—Operation for reducing the size of the nose (Mikulicz). (1) The lower portion of the septum is divided along the dotted line *CD* and is removed; the tip of the nose is incised along the line *BC*. (2) The tip (*A*) is attached to the upper lip. The flap (*BCD*) is folded in to line and form the border of the nostrils. (From Davis, J. S.: Plastic Surgery, New York, Blakiston Company, 1917.)



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Despite Joseph's preliminary work on rhinoplasty by intranasal surgery, he was at this time very little regarded, and the operation for the removal of the hump was done externally, as seen above, with its consequent forbidding mutilation.

The work of Davis has been cited above, not for the purpose of disparagement, for under the circumstances his results were splendid considering the techniques then known and accepted, but in order to emphasize the Herculean strides made in rhinoplasty in a relatively short time.

It was in 1929, exactly 26 years ago, that the cornerstone for modern rhinoplasty was laid, for the first time in history fulfilling Gillies' requirement for a practically possible cosmetic as well as potentially functionally correct operative procedure for changing the size and shape of the nose. It was in that year that Jacques Joseph first published his monumental classic on plastic surgery of the nose and allied structures, the "Nasenplastik und sonstige Gesichtsplastik." This textbook and atlas established Joseph as the father of plastic surgery of the head and neck. Too much cannot be said of its influence on all modern surgeons doing this work today. It has been the point of departure for us all. In him, the art and science of plastic surgery of

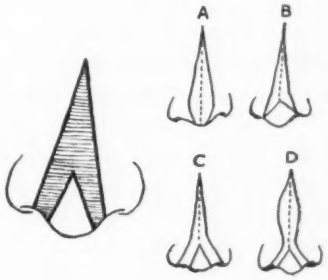

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Fig. 3.—Joseph's operation for reducing the size of a large nose (Roberts). (1) Shaded portion indicates area of tissues excised. (2) Other shapes (*A-D*) which may be excised to suit conditions. (From Davis, J. S.: Plastic Surgery, New York, Blakiston Company, 1917.)

the head and neck emerged in one tremendous, explosive lifetime almost as full-blown as we have it today.

Since Joseph finally summarizes practically the whole operation of rhinoplasty on one page of his book, this page is probably the most important single page in the history of plastic surgery. And since the treatment of surgery of the hump as it is performed today is an important and integral part of this technique, I have taken the liberty of translating this page from the original German as literally as I can. I believe this to be all the more necessary, since Joseph's book has been long out of print and is extremely difficult to refer to today.

The translation of Joseph's procedure for the reduction of the hump follows[8]:

HUMP REMOVAL

(KYPHECTOMY; RHINOKYPHECTOMY)

Hump removal is done in two stages: (1) The intranasal separation of the skin and periosteum and (2) the sawing-off itself. They are accomplished by me in the following manner by means of the intranasal route. After the patient has been prepared and draped according to the principles and methods specified heretofore in the foregoing General Section, the mucosa within the nostril is incised by means of an upward thrust of the double-edged plastic knife [Joseph's straight double-edged knife] inserted at the level of the lower border of the triangular [upper lateral] cartilage; this done on the left side. [Figure 136 shows the incision being done during an actual operation.] This is a photograph showing an upper lateral incision on the left side. [Figure 137 is a schematic diagram of the preceding photograph in the form of an artist's sketch.] In order to perform the incision more adequately, one presses the tip of the nose with the thumb of the left hand in an upward direction, while at the same time with the left forefinger one guards the advance of the point of the knife for the purpose of avoiding a cutting-through of the skin. One then advances with the point of the plastic knife between the upper and lower lateral cartilages from behind, forward, in order to attain the side surface [external] of the nasal bone; the incision is enlarged and the skin above the periosteum elevated. Then the plastic knife is withdrawn from the wound, and into the same route is inserted the somewhat curved-on-the-flat rasp [Joseph's periosteal elevator].

With this the periosteum is detached from the nasal bone from above to the root of the nose and sideward far enough so that one has room in which to insert the saw. At this point the same procedure, from the incision to the detachment of the periosteum, is carried out on the other, on the right side. Then the forward [anterior] tip of the septal cartilage may best be separated by one transversal [incision] created by carrying a button-end knife through both mucosal incisions [previously made]. With this, is the first act of the hump removal fulfilled.

It follows as the second act, the removal itself. One follows through, through one of the incision openings in the mucosa [mostly I prefer the left side] and the straight saw inserted sideways [sagittally] to the bone itself. [Figure 141 shows the saw for the right, Figure 140 for the left, of the approved style]; [these are Joseph's bayonet saws]. This is inserted under directly guided palpation of the left forefinger and placed in the direction of the projected profile line; it then saws under guidance of the left forefinger, with vigorous sawing through first one side, then the septum, and then through the second side. [Figure 149 shows the sawing in a semischematic drawing, Figure 150, the procedure during an actual operation photographed with the saw in place.] Should the sawing-through become too difficult, the fault can be placed in that the teeth of the saw are blocked. In this event the saw is changed. Often it is advantageous to separate the second [right] side by means of a saw for this side [Joseph's right bayonet saw]. Its use also is recommended when one believes that one has not attained the exact direction for the saw cut on the left side.

The bony portion of the hump being separated, one observes carefully its relation and its fixation within the nose. But the hump during this phase of the operation hangs mainly with its neighboring tissues through its attached connection with that of the septum and a part of the upper lateral cartilages. These attachments are resolved into one by introducing a knife in the slit behind the hump, making a button-like structure of the hump by separating it from the underlying tissues in the exact direction of the new profile. So is the hump completely separated, and one has then only to grasp it with a forceps and to withdraw it from one or the other of the nostrils. It is advisable, whenever possible, to remove the hump in one piece, so that it has on its external surface naturally the form of the hump; on the inner surface this takes the shape of a lengthwise-divided boat.

There are several reasons for my having made so literal a translation of the original description by Joseph of his procedure.

In the first place there have been innumerable references to Joseph's technique

in recent years without any actual descriptions of Joseph's own method. When specific references to Joseph's work have been made, it has been difficult to separate the work of the great pioneer and master from that of his commentator. There have been endless variations on the original theme without an exact exposition of the theme itself.

More important, great a piece of work as this was, one suspects at times that Joseph, while describing his method in detail, has omitted certain key details in his descriptions, and it is through a study of the original or an exact translation by means of which one may uncover various of these lacunae. For on careful examination of this description, it may be seen that in a practical sense it is a sort of regular cardiac arrhythmia with periodic dropped beats, these dropped beats preventing the description of the technical procedure from having a complete sense of continuity.

One could hardly perform the operation from this description, no matter how skilled one were, if the procedure as Joseph describes it were exactly followed. For instance, he does not mention how high one is to go in elevating the periosteum, he does not reveal precisely how the two upper lateral incisions are to be connected, and he does not say anything in regard to how the right saw cut is connected with the left or even at what height the saw cut is to be made. All of this and more is inferred, despite the brilliance of the basic procedure taken in toto, and in translation has been embellished by the translator's well-meant imagination and extensive ability obtained by his own, not Joseph's, experience.

If Joseph has been indubitably the father of modern plastic surgery, we are honored to have in our midst at the present time as truly great figures in this field in all of its practical and progressive applications. What Joseph has meant to the origination, rationalization, and the execution of the cosmetically practical operation, such American surgeons as Aufricht, Straatsma, J. B. Brown, and Fomon have meant to its development, its dissemination, and its progress. It is they who have supplied the dropped beats; it is such men as these and many others who have brought plastic surgery of the head and neck from underneath the cape said to have been used by Joseph into the light of a more humanitarian day.

At the present time hump removal is done essentially as Joseph described it basically in the part of his work translated above, with modifications and refinements made by Aufricht and associates, although the chisel and rasp have been used as well for the actual removal of the hump itself. The rasp, except for the very small hump, is not to be contemplated. One has only to try to remove a hump on the cadaver with a rasp, and then to uncover the nasal skin and contemplate the maceration done, to be forever wary of its use. Surgically it can then be seen to be an extremely questionable procedure, except for minor modifications.

The chisel would seem to be the most adequate instrument. The straight-edged, sharp chisel, and even more recently the excellent chisel devised by Silver for the removal of the hump, would seem to be the best answer to the problem. For the chisel, once set and directed upward from the base of the bone, would seem to have adequate direction, exact orientation, and greatly reduced technical difficulty in execution. But it will be seen at once if this procedure is performed on the cadaver, with the skin of the nose completely removed, that, while a good result on the exactly contemplated line is possible, it is much more difficult to perform this removal at the exactly required angle than it would seem; because of the abrupt, repeatedly discontinuous, interrupted blows from the mallet on the head of the chisel, a straight line is difficult to cut, since the line of direction of the separating cut or cuts tends naturally to be in a downward direction, that is, toward the base of the nasal pyramid; unless great care is taken, the superior, cephalic extremity of the removed hump is likely to be excessively deep. It is increasingly more difficult to keep the chisel in the

desired plane as the nasofrontal sutures of the nasal bones are approached. The saw has therefore remained by far the predominating instrument used. It has seemed to me that most of those surgeons who have had their training mainly in Europe or those who have been trained by them have tended to follow Joseph's recommendation as to the use of a single saw in order to saw through both sides, with the one saw as described by Joseph above, while much more frequently two saws have been used—one for sawing through one nasal bone and another for the opposite side—the two saw cuts then being connected and the ethmoid plate being severed by one or the other. While a single saw is very useful in sawing through a small hump, the ordinary hump usually seen presents greater difficulty, since the tip of the nose encroaches more and more on the line of removal the larger the hump which is to be removed.

I have found by working on the cadaver that in regard to joining the two sides several points must be borne in mind.

One will readily observe in sawing a piece of wood that if the saw is not held exactly perpendicularly while the cutting is being done that it will be highly difficult to begin a line of incision exactly where it is desired and that at any other angle the saw will slide and move constantly away from the desired point. This would seem to be an extremely obvious conclusion, but it has not been mentioned often enough. In the nose, therefore, the saw must be high enough that its upper extremity will eventually cut through practically at the top of the hump, while at the same time, until the bone is entirely cut through, the upper angle of the connection must be almost completely disregarded and the nasal bone being separated be thought of as an isolated surface.

In going from one side of the nose to the other, it is commonly stressed that the saw, after having completed the separation in the first side, must be engaged in the bone at the cephalic extremity of the hump to be removed, brought across the dorsum at this point, and made to saw through the dorsum here and then through the cephalic extremity of the intended separation of the second side at the same level at which the other has already been separated. While this is, of course, true, and is probably the only practicably possible solution, it is, nevertheless, true that enough stress has not been placed on the fact that, in order to make this interconnecting link between the two sides upon the dorsum, the handle of the saw must be brought upward laterally as far as is possible. It can be seen on the laboratory specimen, with the bony pyramid completely uncovered, that in order to saw across the dorsum at the comparatively high level usually required the blade of the saw must be not far from 45 degrees from the middorsal line and the nostril must be distorted laterally as far as is possible in order that the saw may penetrate across the dorsum and the upper extremity of the septum at this point in order that the line of separation may be begun on the line of the opposite side.

That the removal of the hump at the proper level by means of Joseph's saw or one of its modifications is technically comparatively difficult has been readily admitted. Therefore various attempts have recently been made to resolve this difficulty. Kazanjian introduced a hump rongeur which could be placed astride the hump and which could remove the hump by cutting the two nasal bones at the same level and at the same time, thus obviating the necessity for incising the second side after a lapse of time long enough to force the operator to again judge the level of the first side of the hump incised.[4] Cottle modified Kazanjian's heavy rongeur slightly by making it with thinner blades and of lighter weight.

But, excellent an advance as Kazanjian's instrument is, I have found it to have several defects. Since it is a scissor-type rongeur, without cross action, the most powerful point of action on compression is at the joint, that is, at the nearer end of the blades to the operator. Therefore, once astride the dorsum the cutting action is maximum at the caudal

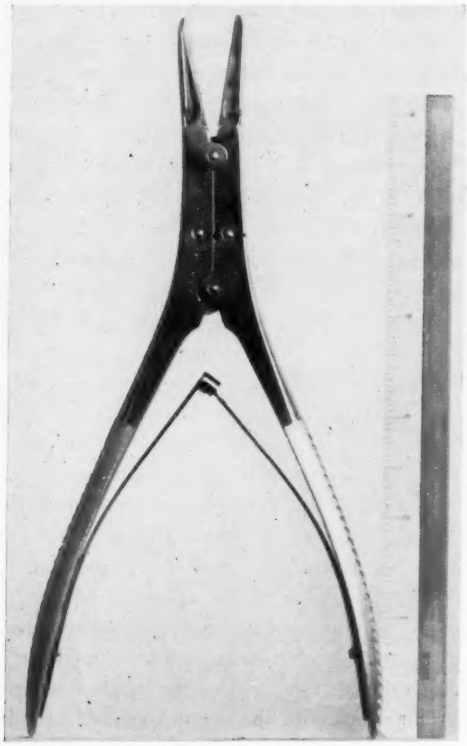


Fig. 4.—Rowland hump rongeur: open.

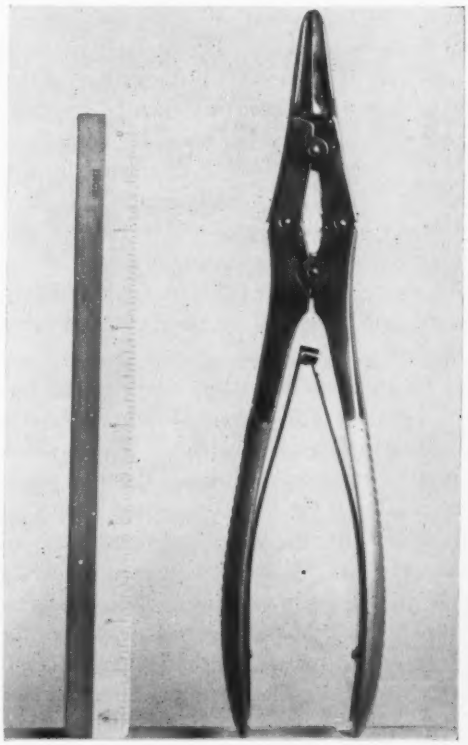
end of the hump to be removed and minimum at its cephalic end, or toward the points of the instrument. At this point, the blades exert comparatively little pressure, and since also at this point the dorsum is most inaccessible and farthest removed from the operator, it is found that the caudal end of the hump can easily be separated but that the cephalic end of the hump is often cut through and removed with great difficulty.

I have therefore devised a cross action hump rongeur in an attempt to solve this part of the problem.† I have tried to combine the sharp, quickly penetrating, incisive action of the chisel with the more exacting, level-controlled mode of action of the saw in one instrument (Figs. 4 and 5). It will be seen, that because of the utilization of the cross action principle, that the considerable force obtained by compression of the handles of the instrument is expressed and distributed evenly along the entire length of the blade, the points at the extremity of the instrument away from the surgeon exerting probably more force than any other part of the blade.

Once the blades are placed over the dorsum at the selected level of the hump to be removed, the cutting action is equally penetrating along the entire line of each nasal bone. The cephalic extremity of the hump being reached at the dorsum, the points will cut through with as equal and ample force by transmission from the handles directly, owing to the cross action principle employed (Fig. 6). Figures 7 and 8 show a patient before and after removal of the hump by means of the hump rongeur I have devised.

It is true that the bone rongeur is not the final solution to the problem of the facile removal of the hump in all cases, but I feel that the use of my cross action rongeur with-

Fig. 5.—Rowland hump rongeur: closed.



† This instrument is manufactured by V. Mueller & Company, 320 S. Honore St., Chicago 12.

Fig. 6.—Modified hump rongeur in actual use.

out or with subsequent use of the saw represents an advance in this direction. In these cases, I have begun with the rongeur, with which it is very simple to cut the guide lines at the desired level at which the saw cuts are to be thereafter made. The preliminary lines thus have been incised on the surface of the nasal bones; the saw may then be inserted, placed on the guide lines, and the separation of the bones then being completed by the classic method of Joseph. Figure 9 is of a case of a long hump removed by this method. Figure 9*A* is an unposed photograph showing clearly the high lights of the long hump nose, and Figure 9*B* the same nose following operation.

Another consideration concerns the approximation of the severed nasal bones. According to the classic method of Joseph, which is still extremely often used, after the actual removal of the severed hump from within the nose and after the lateral osteotomy has been accomplished, all that is done is to infracture the nasal bones toward the midline with pressure by both thumbs directed away from the surgeon and toward the contralateral side. If this is done on the laboratory specimen and the nose then uncovered, it will be found that complete infracture does not usually take place above the cephalic extremity of the removed hump and that those portions of the nasal bones from this point to the nasofrontal angle are not displaced. A glance at one or several skulls will instantly reveal why this is so, and why the dorsum is not changed or lowered throughout its entire length, as is almost invariably the desire of the surgeon, but only along that part of the dorsum which corresponds to that portion of the nasal bones removed during the separation of the nasal hump. It will be seen in sagittal cross sectioning of the skull at the medial line that the upper part of the nasal bones increases rapidly in thickness as the nasofrontal suture is reached, the nasal bone being more than three times as thick at the nasofrontal suture as at its lower extremity, where it articulates with the upper border of the upper lateral cartilage. Therefore if a chisel is not invariably used, and directed in an upward (cephalad) direction at both sides of the midline in approximation with the septum toward and to

Fig. 7.—Patient before operation.

Fig. 8.—Profile views of patient in Figure 7 after operation.

Fig. 9.—*A*, unposed photograph to show high lights of hump; *B*, after operation.

the nasal-frontal suture for the purpose of effectuating a complete separation of the nasal bones above the cephalic extremity of the already removed hump, all that will usually be accomplished is an infracture of a part only of the nasal bone. If the surgeon desires a clean line from tip to glabella in the midline, it would seem advisable that he does not take it for granted that thumb pressure alone will accomplish his intention, but that he separate with a chisel the unsawed portion above the hump to the nasofrontal suture line as well. In addition, he should probably use Walsham's lateral forceps according to the technique employed by Fomon to accomplish the complete separation of these bones.

In order to attain the complete desired freedom for optimum replacement, the ethmoid plate in its anteriosuperior portion should be mobilized as well.

SUMMARY

A historical survey of the modern history of removal of the nasal hump is made. A description of Joseph's method is translated

as literally as possible so that it may be seen in its truest light. Modern modifications are described. A description of a new cross action hump rongeur devised by the author is introduced in the hope that it represents some advance toward the solution of this often underrated problem. More remains to be done. It is hoped and expected that the very great progress of the last two decades towards an ideal solution of a cosmetically practical, easily performed rhinoplasty will be continued.

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Role of Depressor Septi Nasi Muscle in Rhinoplasty

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Secondary dropping of the nasal tip ruins more results in rhinoplasty than any other feature of the operation. Joseph made the observation that there are two results after rhinoplasty: the temporary, and the permanent result. At the end of the operation, the esthetic result is usually satisfactory, assuming that the surgeon has reasonable artistic and surgical skill. Unfortunately, the passing of time frequently brings changes in the contour of the nose, the distressing change being a downward sagging of the nasal tip. This results in a rounded pendulous undesirable tip, a high supratip profile line, and a nose that is too long.

There are two causes that bring about these undesirable changes: (1) linear scar contractures along the septocolumellar suture line, and (2) the downward pull of the depressor septi nasi and orbicularis oris muscles of the lip. In two previous articles, I described the use of Stainless-Steel septocolumellar sutures [1] and the invaginating technique [2] which, I feel, have minimized the first cause. The present article presents a technique which has as its objective the elimination of the second cause—the downward pull exerted on the columella by the depressor septi nasi and orbicularis oris muscles of the lip.

There are two types of nasal tips that one should consider when a rhinoplasty is contemplated: (1) the tip that possesses an adequate or a pronounced forward projection, and (2) the tip that has an inadequate or too low forward projection. The first is always accompanied by a comparatively long columella in its anterior-posterior diameter; the second usually by a short columella.

The nasal tip with adequate forward projection presents no problem to the surgeon. It does not sag after rhinoplasty and retains its newly acquired position regardless of what method is used to attach it to the septum. It should be merely approximated to the septum with plain absorbable surgical sutures closely applied between the columellar skin edges and the septal mucous membrane. Overcorrection or advancing the nasal tip to a higher level on the septum is unnecessary and inadvisable. Neither the invagination technique nor the use of Stainless-Steel sutures is indicated. One anticipates no dropping of the tip under these circumstances.

The chief reason why the tip with adequate projection retains its position is because the depressor septi nasi muscle is not raised from its normal position in the lip during the operation, and therefore exerts no undue downward pull on the normally positioned columella. Scar tissue retraction in this situation is negligible since the exposed areas in the septocolumellar incision are closely approximated by sutures.

The second type of nasal tip (inadequate forward projection and short columella) is difficult to correct and is the type with which we are concerned in this article. The result after operation is not always a happy one even after skilled surgery performed by experienced surgeons. Secondary dropping of the nasal tip often results. In such a situation, the surgeon must lower the cartilaginous dorsum of the septum to the level

Submitted for publication Jan. 31, 1955.

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Fig. 1.—Nasal tip with inadequate forward projection associated with short columella of moderate degree, and wide nostrils.

of the nasal tip. This accomplishes the desired effect in most cases. There is, however, a limitation to the extent to which one can carry out this procedure in some cases since too much removal of the cartilaginous dorsum of the septum might conceivably produce a profile line that is too low or a nose that is too small. After the hump has been removed and the cartilaginous dorsum of the septum has been lowered, the resulting nasofacial angle should measure between 30 and 40 degrees. A 35-degree nasofacial angle is ideal. It should never be less than 30 degrees; otherwise, a flattened snub nose would result. Under such circumstances, one is forced to raise the newly formed tip to the level of the new profile line. This necessitates advancing the columella on the septum—the only situation where one is justified in overcorrecting. Unfortunately, this maneuver produces an upward pull or tension on the muscles of the upper lip and raises the depressor septi nasi muscle out of its normal position. Any such tension on the muscle simulates a stretched rubber band which always tends to return to its original position

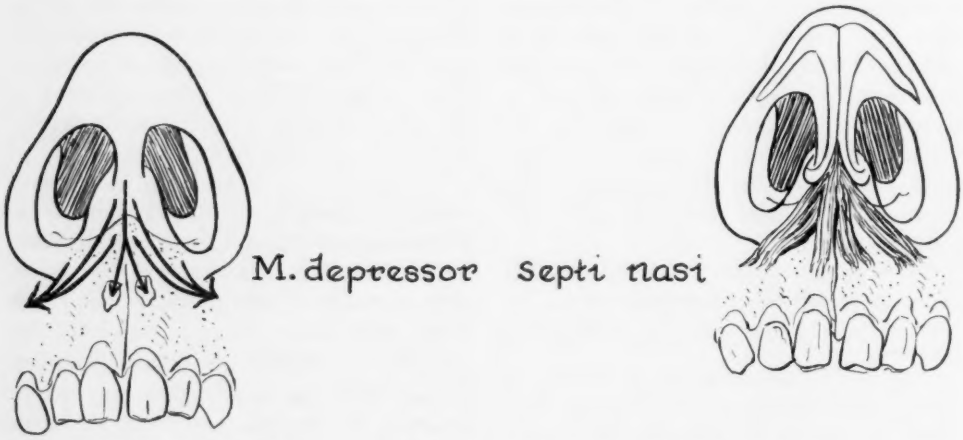


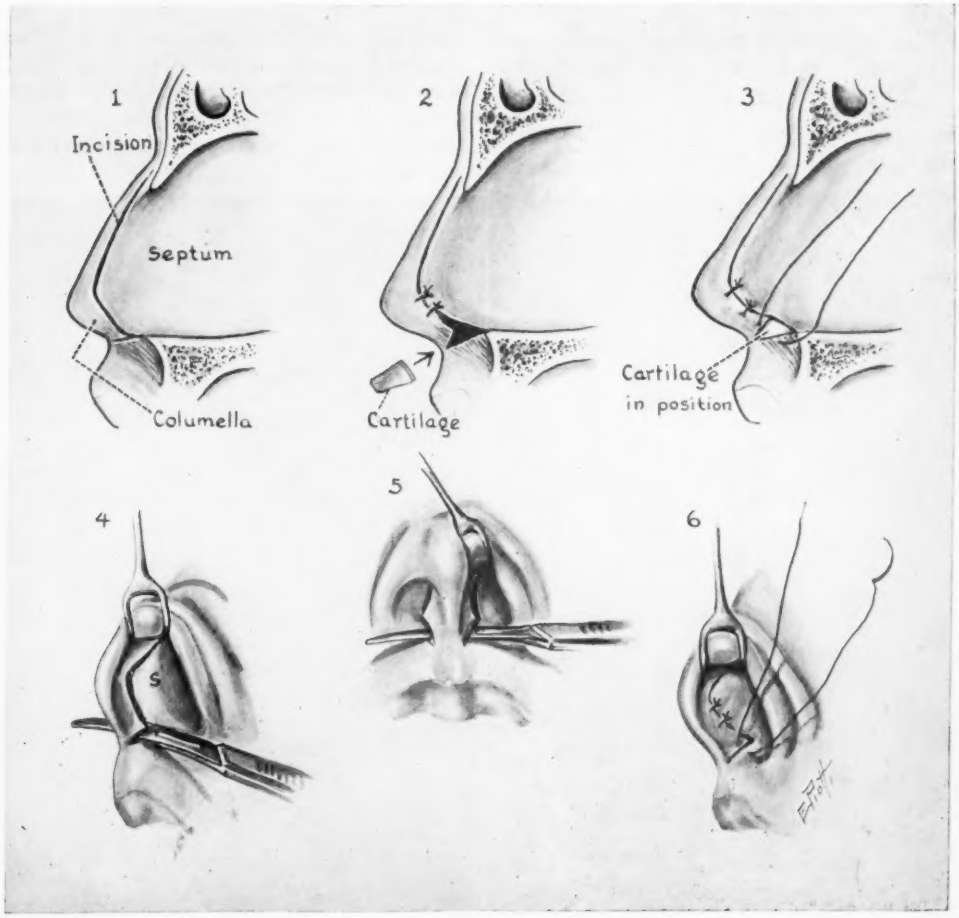
Fig. 2.—Origin, insertion, and action of depressor septi nasi muscle.

unless otherwise restrained. The result is a tip that is pulled back to the position it had before overcorrection. Secondary dropping of the nasal tip results.

The problem in this situation is to retain the columella and tip in their new overcorrected position. The invaginating technique and the use of Stainless-Steel sutures are definitely indicated when the tip is overcorrected, since these two procedures hold the columella secure in its new elevated position. The strong downward pull of the depressor septi nasi muscle, however, must be overcome or eliminated if the tip is to retain the newly acquired elevated position given it at operation.

We have all seen preoperative cases where the tip of the nose bobs up and down during the act of speaking. This is due to the excursive movements of the columella, which is influenced by the depressor septi nasi muscle. This muscle originates from the incisor fossa of the superior maxilla and is intimately intertwined with the fibers of the orbicularis oris muscle of the lip. If one could eliminate or minimize the effect of these muscles by

Fig. 3.—(1) "Lip-freeing" incision almost severing columella from lip. (2) Columella has been overcorrected on septum and held in elevated position by Stainless-Steel sutures. Triangular space created in lateral wall of columella. (3) Wedge-shaped free-cartilage transplant inserted in columella. (4 and 5) Knife held in horizontal position severs all the fibers of the depressor septi nasi muscle in the columella. Both lateral walls of the columella are also incised. A thin bridge of intact skin joins the columella to the lip. (6) Vestibular skin stretches and is sutured to hold cartilage transplant in position.



operation, one could to a reasonable degree anticipate success in keeping the newly fashioned tip in the raised position given it at operation.

I have used the following technique in 11 cases to accomplish this and have been very much gratified by the results. The first case was operated on one year ago. I wish to stress that the employment of this "lip-freeing" technique is advocated only in those cases which present a tip with inadequate forward projection and are accompanied by a short columella. The principle of the technique is the section of all the fibers of the depressor septi nasi muscle in the columella. This allows the lip to function in its own sphere without any effect on the raised position of the columella and nasal tip.

TECHNIQUE

After the hump has been removed and the nose shortened, a No. 15 Bard Parker blade is introduced in the transfixion incision at its lower end near the nasal spine. It is held horizontally with the sharp edge of the blade turned forward at a right angle to the transfixion incision. With a sawing motion it is brought forward toward the nasolabial angle until it severs almost the entire body of the columella from the lip. The incision, however, must stop just short of the skin on the anterior surface of the columella at its junction with the upper lip. A thin bridge of intact skin—2 or 3 mm. in thickness—joins the lip to the columella. The incision lies in a horizontal plane and severs both lateral skin surfaces of the columella. The incision is situated at a lower level in the columella than the lower ends of both medial crura cartilages. Every precaution must be taken to confine the incision to the columella and not allow it to enter the lip itself. Otherwise, unnecessary trauma and swelling of the lip would result. The sharp edge of the blade can be palpated subepithelially just under the skin at the nasolabial angle. No skin marks or scars result from the incision. The blood supply to the columella is ample and is supplied from the region of the nasal tip.

The columella should now be advanced on the caudal edge of the nasal septum and the tip overcorrected by Joseph's orthopedic suture with Stainless-Steel thread. The suture is applied high on

Fig. 4.—"Before and after" pictures. Left, before operation. Right, 11 months postoperatively. Stainless-Steel suture and lip-freeing technique used without invagination.

the septum and low on the columella. The invaginating technique is advisable and should be utilized in this situation though its use is not indispensable.

After the septocolumellar sutures are tied, one invariably observes that the edges of the incisions in the lateral surfaces of the columella are separated. These appear in the form of a triangular opening in each lateral wall of the columella and indicate that the overcorrection is adequate. Unless one observes this triangular space one must conclude that the columella has not been raised enough on the septum. Effective separation of the columella from the lip except for the thin bridge of skin at the nasolabial angle is the objective of the lip-feeing technique.

The space actually created in the columella is a flat wedge-shaped segment or pyramid. The apex of the pyramid is situated on its anterior surface. The base of the pyramid is cephalic in position and lies on the transfixion incision near the nasal spine. Since nature abhors any unoccupied space, it is advisable to fashion and insert a wedge-shaped free-cartilage transplant into the newly created space in the columella. The presence of the cartilage transplant prevents the fibers of the depressor septi nasi muscle from reuniting, and minimizes resulting scar contractures which normally follow any incision. Cartilage from the septum or from the lower end of the upper lateral cartilage is suitable for this purpose. Dermalon sutures (skin and tension sutures processed from nylon) are used to unite the columellar skin edges to the septal mucous membrane and hold the cartilage transplant securely in place. The columellar skin edges stretch and accommodate themselves during suturing. The depressor septi nasi muscle is now rendered inactive and is ineffectual long enough to allow the columella to become secure and firmly healed in its new overcorrected position on the septum. The lip muscles may now act to their fullest extent without exerting any influence on the position of the columella.

The septocolumellar sutures should always be tied before the tip is modeled. This provides a firm and stable foundation upon which the tip may be modeled. If the upper edges of the medial crura are sutured together back to back at the alar angle, the projection of the tip will be slightly increased and will to a small degree reduce the amount of overcorrection needed.

SUMARY AND CONCLUSION

A new "lip-freeing" technique to prevent secondary dropping of the nasal tip after rhinoplasty is described. Its objective is to maintain the position of the overcorrected columella on the septum. This technique is indicated only for those cases which present a nasal tip with a short columella and inadequate projection of moderate degree. It is not meant to apply to those cases where the columella is absent or where the tip of the nose is drawn down almost to the upper lip.

The suggestion that a wedge-shaped free-cartilage transplant be inserted in the columella to prevent scar formation was made by Dr. Louis M. Friedman.

Dr. John M. Converse, of New York, furnished the drawing of the depressor septi nasi muscle.

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The Treatment of Purulent Otogenic Meningitis

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INTRODUCTION

In the treatment of purulent otogenic meningitis, it is extremely important to institute chemotherapy after the complete exenteration of the primary focus of the infection in the temporal bone. A radical mastoidectomy and, if necessary, even a petrosectomy should be performed without hesitation.

The present study was undertaken to determine the amount of penicillin necessary to maintain the optimal concentration in the cerebrospinal fluid without at the same time causing any serious side-reactions. Clinical observations were made on seven patients with otogenic meningitis. In addition, 40 rabbits were used in these experiments.

The observations made fall into four main categories: (1) the penicillin concentration in the cerebrospinal fluid and blood as a function of time after injection of penicillin by two general methods, extrathecal and intrathecal; (2) a comparison of the amount and duration of penicillin concentration in the cerebrospinal fluid obtained by injection of penicillin by means of cisternal and lumbar puncture; (3) a method of guarding against unexpected serious side-reactions resulting from intrathecal application of penicillin as determined by in vitro experimentation; (4) the clinical results of this treatment.

EXPERIMENTAL PROCEDURE

Forty rabbits were inoculated by the injection of 0.1 cc. of hemolytic streptococci in bouillon into the labyrinth through the round window. In order to maintain the experimental conditions as constant as possible, measurements of pleocytosis were made 48 hours after injection, and only those animals with from about 500 to 2000 leucocytes in the spinal fluid were generally used in the experiment.

Submitted for publication July 3, 1954.

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RESULTS AND COMMENT

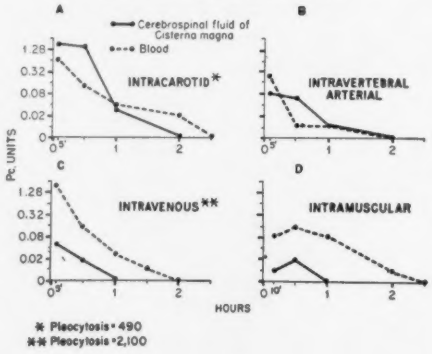
I. The Penicillin Concentration and Duration in Cerebrospinal Fluid as a Function of the Method of Application (Extrathecal or Intrathecal)

A. Extrathecal Application of Penicillin.—The following four extrathecal procedures were compared with regard to the diffusion of penicillin into the spinal fluid: (*a*) intracarotid injection; (*b*) intravertebral arterial injection; (*c*) intravenous injection, and (*d*) intramuscular injection.

(*a*) Intracarotid Arterial Injection: The solid line in Figure 1*A* shows penicillin concentration in the cerebrospinal fluid as a function of time. These measurements were obtained by cisternal puncture after the intracarotid arterial injection in rabbits of 600 units of penicillin per kilogram. The dotted line represents the concentration of penicillin in the blood of the jugular vein on the same side. As seen in this figure, the penicillin concentration in the spinal fluid measured 5 minutes after injection was 1.8 units; at 30 min-

FIGURE 1

Penicillin Concentration Following Injection of 600u/Kg. Pc. in Rabbits



utes, 1.5 units, and at two hours it was totally absent. On the other hand, the penicillin concentration in the blood was 0.7 unit 5 minutes and 0.13 unit 30 minutes after injection. It is seen, therefore, that the penicillin concentration in spinal fluid is about 2.5 times that of blood at 5 minutes and 5 to 10 times that of blood at 30 minutes.

(*b*) Intravertebral Arterial Injection: The solid line in Figure 1*B* shows penicillin concentration in the cerebrospinal fluid as a function of time. Measurements of penicillin concentration were obtained at the various times indicated in Figure 1*B* after intravertebral arterial injection of 600 units of penicillin per kilogram. The dotted line in Figure 1*B* indicates penicillin concentration in the blood. As seen in Figure 1*B*, the penicillin concentration in the spinal fluid is generally higher than that found in blood. The intravertebral arterial method of injection, however, would appear to be less valuable than the intracarotid method in view of the generally lower penicillin concentration and the relative difficulty of the injection technique in the former method.

(*c*) Intravenous Injection: Figure 1*C* shows the results obtained by intravenous injection of penicillin. As seen in this figure, the penicillin concentration in the cerebrospinal fluid is only 0.05 units at 5 minutes, almost insignificant at 30 minutes, and totally absent at one hour after injection. The penicillin concentration in the cerebrospinal fluid is generally small compared with the relatively large concentrations found in the blood with this method.

(*d*) Intramuscular Injection: Figure 1*D* shows the results obtained by intramuscular injection of penicillin. The penicillin concentration in the blood is seen to be always greater than the concentration found in the cerebrospinal fluid with this method of injection. It is seen, for example, that the penicillin concentration in the cerebrospinal fluid is 0.02 units 30 minutes after injection and totally absent one hour after injection. The penicillin concentration in the blood, on the other hand, is 0.15 units at 30 minutes, 0.09 units at one hour, and totally absent at two hours 30 minutes after injection.

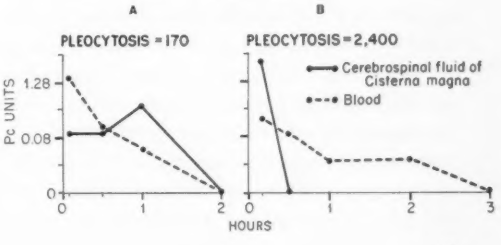
In view of the results obtained on experimental animals with these four injection methods, it would be considered that the intracarotid arterial injection is the best method in terms of the criterion of maximal diffusion of penicillin into the cerebrospinal fluid. The intravertebral arterial injection method, the intravenous injection method, and the intramuscular injection method in that order are increasingly less efficacious.

Attention was next turned to the problem of determining the optimum dosage of penicillin for an injection. Three methods of injection, namely, intracarotid, intravenous, and intramuscular, were studied in this regard in both rabbits and patients.

(*a*) Intracarotid Arterial Injection: Using the intracarotid arterial injection technique, the penicillin concentrations in cerebrospinal fluid resulting from dosage of 600 units, 1000, and 2000 units of penicillin per kilogram were compared. The graph showing penicillin concentration in cerebrospinal fluid and blood as a function of time after injection of 600 units of penicillin per kilogram has been shown previously. Figure 2 shows two different curves representing penicillin concentration in cerebrospinal fluid as a function of time after injection of 1000 units of penicillin per kilogram. In Figure 2*A*, the concentration is seen to be maintained longer than that shown in Figure 2*B*. The concentration, however, is greater in Figure 2*B*, but falls off very rapidly. In other words, the penicillin concentration in the spinal fluid shown in Figure 2*A* is not as great as it is in Figure 2*B*, but its duration is longer. The maintain-

FIGURE 2

Penicillin Concentration Following Intracarotid Injection of 1,000u./Kg.Pc. in Rabbits



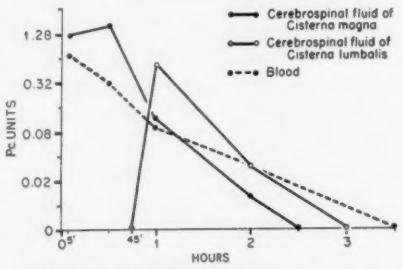
ing of the penicillin concentration at a fairly constant low level and over a relatively long period of time shown in Figure 2*A* may conceivably be accounted for by the slight inflammation of the meninges indicated by the pleocytosis measurement of 170 leucocytes. Figure 2*B*, on the other hand, shows a relatively greater penicillin concentration measured 10 minutes after injection (3.2 units), but this concentration disappears completely in a short time (30 minutes after injection). The nature of the curve of Figure 2*B* might possibly be explained by the severe inflammation of the meninges which was indicated by the pleocytosis measurement of 2400 leucocytes. It would seem, therefore, that the diffusion of penicillin into the cerebrospinal fluid is indirectly related to the severity of meningeal inflammation. In other words, it would appear that when the meningeal inflammation is severe, the greater permeability of the meninges allows the penicillin to be passed into the cerebrospinal fluid quite readily and conversely allows the penicillin to be readily reabsorbed into the blood. Injection of 2000 units of penicillin per kilogram reveals a momentarily higher concentration in the cerebrospinal fluid than is the case in the 1000 unit injection. The duration of the 2000 unit injection, however, is only 30 to 60 minutes. It appears, therefore, that the duration of concentration of penicillin in the cerebrospinal fluid is not directly proportional to the dosage of penicillin injected. The duration, in fact, appears surprisingly short in view of the relatively large dosage. The penicillin concentration in the cerebrospinal fluid measured soon after injection (10 minutes), however, is relatively great, as would be expected from the relatively large dosage. In view of the foregoing, it would appear that a reasonable therapeutic dosage to be used at one time would be 600 units of penicillin per kilogram.

Measurements of the amount and duration of penicillin concentration in the cerebrospinal fluid of patients were obtained by simultaneous cisternal and lumbar punctures. These measurements were obtained in order to discover the relationship between dosage and duration of penicillin concentration in the cerebrospinal fluid of the cisterna magna and the cisterna lumbalis.

Figure 3 shows the distribution of penicillin concentration in the cerebrospinal fluid after intracarotid arterial injection of 600 units of penicillin per kilogram (approximately 30,000 units in Japanese adults). Penicillin concentration as a function of time is indicated for the cisterna magna (solid dotted line), cisterna lumbalis (solid circle line), and the blood (dotted line). The solid dotted curve agrees quite well with the similar curve for rabbits, e. g., penicillin concentration measured 30 minutes after injection is 1.62 units in the former case and 1.50 units in the latter

FIGURE 3

Penicillin Concentration Following Intracarotid Injection of 600u/Kg. Pc. (≅ 30,000u.) in Otogenic meningitis *



* Pleocytosis = 3210/3
Initial Cerebrospinal fluid pressure = 230mm.H_2O

case. The duration of penicillin concentration, however, differs. In patients, the duration of penicillin concentration is two hours and 30 minutes at cisterna magna, usually longer than it is in rabbits. A more interesting point, illustrated in Figure 3, is that it takes about 45 minutes after intracarotid arterial injection for the penicillin concentration in the cisterna lumbalis to reach a measurable level. At one hour after injection, the penicillin concentration reaches its peak, and at three hours completely disappears.

The penicillin concentration and duration in the cerebrospinal fluid of the cisterna magna after intracarotid arterial injection of 30,000 units and of 100,000 units of penicillin were compared. The duration following injection of 100,000 units was not markedly prolonged as compared with the duration following in-

jection of 30,000 units. The concentration, however, was of course higher immediately after injection in the case of the 100,000 unit injection than it was in the case of the 30,000 unit injection.

In view of the foregoing experimental and clinical findings, it is suggested that the optimum single dosage of penicillin by means of intracarotid arterial injection is about 600 units per kilogram for the typical case. In severe cases, however, dosages of 1000 or even 2000 units per kilogram may not be unwarranted, since the main purpose of the intracarotid arterial injection is the sudden attack of the pathological tissue by means of a high penicillin concentration.

(*b*) Intravenous Injection: The solid curve of Figure 4 shows the concentration and duration of penicillin in the cerebrospinal fluid as measured by cisternal puncture after injection of 2000 units of penicillin per kilogram (approximately 100,000 units in the adult). As seen in this figure, the cerebrospinal fluid level of penicillin reaches a peak of 0.08 units 10 minutes after injection, which is far below the peak value of 1.10 units found following intracarotid arterial injection of same units of penicillin in same patient. The penicillin concentration in the cerebrospinal fluid following intravenous injection of 2000 units of penicillin per kilogram is seen to disappear completely two hours and 30 minutes after injection. The intravenous injection, however, was found to be superior to the intramuscular injection, which is discussed below.

FIGURE 4

Penicillin Concentration Following Intravenous Injection of 2,000 u./Kg. Pc. (≅ 100,000 u.) in Otogenic meningitis

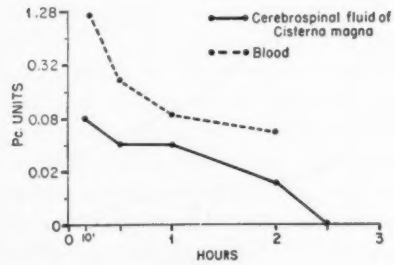
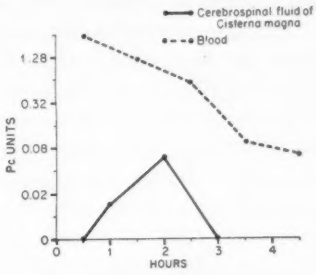


FIGURE 5

Penicillin Concentration Following Intramuscular Injection of 4,000 u./Kg. Pc. (≅ 200,000 u.) in Otogenic meningitis *



* Pleocytosis = 1660/3
Initial Cerebrospinal fluid pressure = 180 mm. H_2O

(*c*) Intramuscular Injection: The solid curve in Figure 5 indicates the concentration of penicillin in the cerebrospinal fluid of the cisterna magna following intramuscular injection of 4000 units of penicillin per kilogram (approximately 200,000 units). The penicillin concentration is seen to reach a peak of only 0.06 at two hours and disappear at three hours after injection. The penicillin concentration in the blood, however, is seen to reach a peak of 2.50 units at 30 minutes and decline to 0.04 units at six hours and 30 minutes after injection.

Judging from these clinical and experimental results, it would appear that intramuscular injection is a relatively ineffective and wasteful procedure. It is to be remembered, furthermore, that individuals are likely to show moderate differences in the amounts of penicillin in the cerebrospinal fluid and in the blood following intramuscular injection. The penicillin concentration in the cerebrospinal fluid following intracarotid arterial injection, on the other hand, would seem to assure a much higher concentration than that obtained by any other procedure.

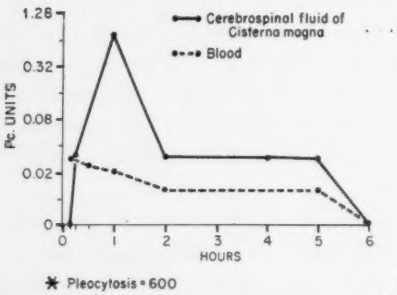
Experiments were performed to determine whether sulfadiazine, sulfamerazine, and carinamide would promote the diffusion of penicillin into the cerebrospinal fluid. Only carinamide was found to have such an effect, which is in accordance with the reports [1] found in the literature. The use of carinamide in the case of meningitis, however, does not

seem to be a satisfactory procedure in view of the observation by Meads and Long[2] that nausea and vomiting may increase through the disturbance of kidney function, if this drug is applied continuously for over three days.

B. Intrathecal Application of Penicillin.—The intrathecal application of penicillin has been strongly objected to by neurologists (e. g., Wilson,[3] Walker,[4] and others) because of the possibility of serious side-reactions. It is, of course, obvious that we should always be aware of the possibility of unexpected accident in the intrathecal treatment of meningitis. It is the writer's opinion that intrathecal application of penicillin is the most effective treatment for such serious diseases as otogenic meningitis, provided that a procedure for

FIGURE 6

Penicillin Concentration Following Lumbar Puncture Injection of 400u./Kg. Pc. in Rabbits *



* Pleocytosis = 600

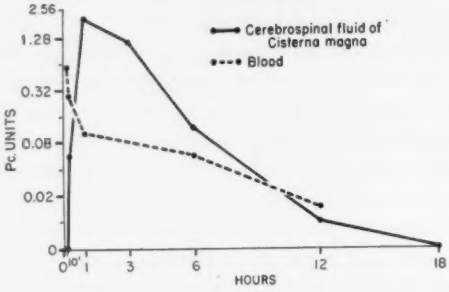
guarding against serious side-reactions is followed. Experiments were conducted in order to discover such a procedure as well as to ascertain the minimal effective dosage of penicillin to be applied intrathecally.

(*a*) Lumbar Application of Penicillin: Figure 6 shows the relationship between the penicillin concentration in the cisterna magna and blood of rabbits after injection of 400 units of penicillin per kilogram by means of lumbar puncture. It is seen that the time required for the diffusion of penicillin from the cisterna lumbalis to the cisterna magna is about 10 to 15 minutes, and that the penicillin concentration, in both spinal fluid and blood, disappears six hours after injection.

A similar relationship is shown in Figure 7. Twenty thousand units of penicillin was ap-

FIGURE 7

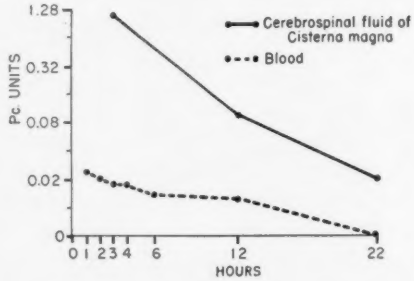
Penicillin Concentration Following Lumbar Puncture Injection of 20,000u. Pc. in Otogenic meningitis



plied intrathecally by means of lumbar puncture, and the penicillin concentration in the cerebrospinal fluid was measured at the cisterna magna. It is seen in Figure 7 that the time required for the diffusion of the penicillin concentration from the cisterna lumbalis to the cisterna magna in patients is also approximately 10 to 15 minutes. The penicillin concentration is seen to reach a peak of 2.05 units at 1 hour and disappear at 12 to 18 hours after injection. Another point to be noticed in this procedure is that the penicillin concentration in blood remains markedly high after it has been applied. Figure 8 shows penicillin concentration in the cerebrospinal fluid of the cisterna magna and blood following intrathecal application of 10,000 units of penicillin by means of cisternal puncture. Comparing cisternal and lumbar punctures (Figs. 8 and 7 respectively) it is seen that the penicillin concentration and duration in the cerebro-

FIGURE 8

Penicillin Concentration Following Cisternal Puncture Injection of 10,000u. Pc. in Otogenic meningitis



spinal fluid of the cisterna magna following application by means of cisternal puncture is greater than that by means of lumbar puncture. It is seen, for example, that the penicillin concentration is 0.01 units at 12 hours following lumbar application of 20,000 units of penicillin, but 0.02 units at 22 hours following cisternal application of 10,000 units of penicillin. A comparison of Figures 7 and 8 reveals that the penicillin concentration in the blood following injection by means of lumbar puncture is greater than that following injection by means of cisternal puncture. A possible explanation would seem to be that large amounts of penicillin intrathecally applied by means of lumbar puncture are absorbed from the spinal fluid into the blood of the spinal canal, thus resulting in decreased penicillin concentration in the cisterna magna.

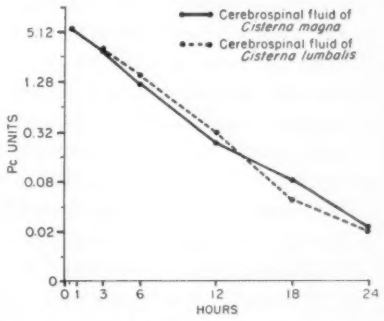
It would be considered, therefore, that an effective concentration of penicillin remains in the cerebrospinal fluid of the cisterna magna for about 12 hours following injection of 400 units of penicillin per kilogram (approximately 20,000 units in adults) by means of lumbar puncture.

(*b*) Cisternal Application of Penicillin: The next series of experiments were concerned with measuring simultaneously the penicillin concentration in the blood and in the cerebrospinal fluid of the cisterna magna and the cisterna lumbalis, following the injection in patients of 10,000 to 15,000 units of penicillin (approximately 200 to 300 units per kilogram) by means of cisternal puncture. Figure 9 shows the penicillin concentrations measured simultaneously in the cerebrospinal fluid of the cisterna magna and the cisterna lumbalis after injection of 15,000 units (approximately 300 units per kilogram) of penicillin by means of cisternal puncture. It is seen in this figure that the penicillin concentrations in these two places measured any given time after injection are quite similar. In addition, a significant penicillin concentration (0.02 units) remains at 24 hours after cisternal application, while the last significant penicillin concentration measurement (0.01 units) following lumbar application is at 12 hours. A possible explanation for this finding seems to be that less of the penicillin concentration is absorbed into the blood circulation following cisternal application than following lumbar application.

In view of these findings, it is suggested that the optimum single daily dosage of penicillin applied by means of cisternal puncture for the treatment of meningitis caused by penicillin-sensitive bacteria is of the order of 200 to 300 units per kilogram. In addition, it appears desirable to elevate the penicillin concentration of the cerebrospinal fluid in the region of the base of the brain by means of intracarotid arterial application of from 600 to 1000 units of penicillin per kilogram given two or three times daily.

FIGURE 9

Penicillin Concentration Following Cisternal Puncture Injection of 15,000 u. Pc. in Otogenic meningitis



II. A Method of Guarding Against Unexpected Serious Side-Reactions Resulting from Intrathecal Application of Penicillin as Determined by in Vitro Experimentation

A new device was developed for the purpose of guarding against side-reactions resulting from the intrathecal application of penicillin. This device consists of the following in vitro procedure: Penicillin (in various concentrations) and 3 drops of 3% acetic acid are added to the spinal fluid; this test tube mixture is placed in an incubator for 12 to 48 hours; the precipitate is examined at the end of this time. This procedure was tried, using the spinal fluid of 10 normal persons and 8 patients with meningitis. A positive result (fibrinoid precipitation) was obtained with the spinal fluid of 1 of 10 normals and with 1

TABLE 1.—*Fibrinoid Precipitation (in Vitro) in Cerebrospinal Fluid Caused by Adding Penicillin and 3% Acetic Acid*

(A) NORMAL*

SPINAL FLUID c.c.	PENICILLIN units	3.0% ACETIC ACID 3gtt.	FIBRINOID PRECIPITATION
1.0	100	–	(–)
1.0	500	–	(–)
1.0	750	–	(–)
1.0	1,000	–	(+)
1.0	5,000	–	(+)
1.0	–	+	(–)
–	15,000	+	(–)
1.0	–	–	(–)
0.5	500	+	(+)
0.5	1,000	+	(+)
0.5	2,500	+	(++)
0.5	5,000	+	(+++)
0.5	5,000	–	(±)
0.5	–	+	(–)
–	5,000	+	(–)

(B) PURULENT MENINGITIS**

SPINAL FLUID c.c.	PENICILLIN units	3.0% ACETIC ACID 3gtt.	FIBRINOID PRECIPITATION
1.0	250	–	(+)
1.0	250	+	(++)
1.0	500	–	(+)
1.0	500	+	(++)
1.0	1,000	–	(+)
1.0	1,000	+	(+++)
–	500	+	(–)
1.0	–	+	(–)

Control.

* 37°C., 24-36 hrs. in Incubator
** 37°C., 24 hrs. in Incubator

of the 8 patients with meningitis. Table 1 (*A*) shows the results obtained with this method on two occasions separated by an interval of 10 days using the spinal fluid of the one normal person who showed fibrinoid precipitation. It is seen in Table 1 (*A*) that the greater the penicillin added to the spinal fluid, the more precipitate is developed. In addition, the precipitation is seen to be promoted by adding 3% acetic acid. It is seen, for example, that 1.0 cc. of spinal fluid plus 750 units or less of penicillin without acetic acid shows no precipitation. Increasing the penicillin to 1000 units or greater in the above-mentioned situation, however, does result in precipitation of fibrinoid substances. On the other hand, 0.5 cc. of spinal fluid plus 500 units of penicillin with 3% acetic acid added shows moderate precipitation (indicated by +), while adding 5000 units of penicillin to 0.5 cc. of spinal fluid without acetic acid shows slight precipitation (indicated by ±). Extremely marked precipitation (indicated by +++) is obtained with 0.5 cc. of spinal fluid plus 5000 units of penicillin with acetic acid added.

Table 1 (*B*) shows the results obtained with the spinal fluid of the one patient with meningitis who showed fibrinoid precipitation. It is seen that the greater the penicillin added to the spinal fluid, the more precipitate results, and that the presence of 3% acetic acid promotes precipitation while its absence decreases precipitation. It will be remembered that similar findings in Table 1(*A*) were pointed out for the spinal fluid of the normal person.

Since the above-described procedure occasionally reveals fibrinoid precipitation in the spinal fluid of normals as well as in the spinal fluid of patients with meningitis, it would appear that such precipitation might be attributed to constitutional factors, to the impurity of the penicillin, or to other unknown causes. Even in the case of a patient with an extremely poor constitution, however, the occurrence of side-reactions does not seem likely if the penicillin is administered in dosages which are as small as possible. In any case, susceptibility to the production of side-reactions resulting from intrathecal application of penicillin may be determined by the in vitro procedure described above. It is suggested that this in vitro procedure be administered to all patients for whom intrathecal application of penicillin is contemplated.

III. The Clinical Results of This Treatment

Clinical results using the method of penicillin application described previously are shown in Table 2. Since only seven cases with otogenic meningitis are reported, a valid evaluation of the treatments is, perhaps, not possible.

As seen in this table, the three surgical procedures used for the exenteration of the pri-

TABLE 2.—*Data for Seven Patients Treated*

PATIENT		AGE	SEX	OPERATION	PENICILLIN UNITS INJECTED					RESULTS OF TREATMENT
					Intracarotid	Intravenous	Intramuscular	Intrathecal	TOTAL	
1	TT	20	M	Petrosectomy (*Ramadier*) with Radical Mastoidectomy	1,500,000	250,000	–	775,000	2,525,000	Cured
2	ON	64	M	*Voss-Grunert* Operation with Radical Mastoidectomy	2,100,000	100,000	100,000	115,000	2,415,000	"
3	TM	20	M	Radical Mastoidectomy	–	–	1,400,000	135,000	1,535,000	"
4	NT	16	F	Surgery for Lateral Sinus Thrombosis with Radical Mastoidectomy	300,000	630,000	2,000,000	145,000	3,075,000	"
5	IK	34	M	Radical Mastoidectomy	360,000	1,000,000	1,570,000	140,000	3,070,000	"
6	TC	19	M	–	–	1,230,000	9,180,000	132,000	10,542,000	"
7	YC	33	M	–	–	–	4,000,000	485,000	4,485,000	Expired

mary focus of infection were (1) radical mastoidectomy, (2) petrosectomy, and (3) Voss-Grunert's operation (a combined operation for the removal of a thrombosed sigmoid sinus, jugular vein, and jugular bulb). In two cases, no surgery was performed because of strong objections by the family. One of these patients died. In the other case, where the patient came to the clinic revealing a lessening of acute exacerbation of chronic otitis media resulting from penicillin treatment by a local physician, good results were obtained by these treatments. As seen in Table 2, satisfactory results were obtained with intrathecal application of from 115,000 to 775,000 units of penicillin and intracarotid arterial application of from 300,000 to 2,100,000 units of penicillin.

SUMMARY AND CONCLUSIONS

In the treatment of otogenic purulent meningitis, it is extremely important to institute chemotherapy after the complete exenteration of the primary focus of the infection in the temporal bone.

Regarding the diffusion of penicillin into the cerebrospinal fluid in extrathecal application, intracarotid arterial injection is the best method, followed by intravertebral arterial injection, intravenous injection, and intramuscular injection, in that order. It should be emphasized that intramuscular injection is generally not as effective as the other procedures described.

It is suggested that the optimum single dosage of penicillin by means of intracarotid arterial injection is of the order of 600 to 1000 units per kilogram; it seems desirable to repeat this dosage two to three times a day.

In intrathecal applications, the cisternal puncture is more effective than the lumbar puncture. In cisternal puncture an optimum daily dose of penicillin appears to be of the order of 200 to 300 units per kilogram. Since the diffusion of penicillin to the region of the base of the brain and spinal cord is greater for cisternal puncture than for any other procedure, cisternal puncture insures not only a higher penicillin concentration, but also a longer duration of significant concentration.

A new supplementary procedure for guarding against serious side-reactions resulting from intrathecal application of penicillin is suggested. It is observed that the precipitation of fibrinoid substances is promoted by the addition of 3% acetic acid to the cerebrospinal fluid in vitro.

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Voice Physiology and the Emergence of New Vocal Styles

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The earliest act performed by a human infant after breathing is instituted is to cry. This first cry is an unconscious reflex act, evoked by the change of temperature, by the stimulation of the air on the skin, and by the light on the eye. During the first weeks the crying continues to be a reflex act, evoked by hunger and pain. Very soon, however, the infant realizes that when he cries his mother comes to feed him, to calm him, and to change his diapers. From now on, crying becomes a conscious, intentional act. As early as around the fifth or sixth week, an observant mother can distinguish between the crying of hunger and pain and the sounds which the infant produces thanks to pleasurable sensations. More and more, the crying is used to express a range of different feelings, is evaluated accordingly, and becomes a source of information for the environment. Throughout life, it remains an essential mode of expression for a great variety of sentiments.

Man shares this ability to produce voice and by modulation of this voice to express emotions with nearly all mammals. (The mating cry of many animals can serve as proof for the close connection between emotional life and voice emission.) Man can use his voice to express a great variety of emotions without even knowing how he does it. Love and hate, anger and satisfaction, hope and despair, joy and sorrow, wooing and rejection, all can be expressed by a lilt of the human voice. "C'est-le ton qui fait la musique," says the Frenchman with conviction. Better than any words can do it, the sounds by means of which they are uttered will convey the speaker's feelings. But not only his momentary feelings are registered in the sound of a person's voice; it can be recognized whether the speaker is a man or a woman, old or young, educated or uneducated, nervous or calm, excited or in good cheer. One can recognize if he is pedantic or easy-going, trustworthy or a hypocrite. The voice of a nagging Xanthippe, even if she is momentarily not nagging, will indicate her permanent character. The alcoholic, even sober, will be betrayed by his voice, and what is usually called charm in a person is to the greater extent a kind of modulation or inflection of the voice which seems pleasant to a great number of persons.

However, a voice which is harsh or mutilated immediately loses all the ingratiating qualities which were just mentioned. A raucous voice cannot play on the emotions of the listener, cannot kindle his sympathy, cannot arouse his enthusiasm. It will only grate on his nerves and will compel him to choose among several unpleasant diagnoses. The listener may, e. g., think that the speaker suffers from laryngitis, tuberculosis, or cancer of the larynx.

The human voice,* as we hear it, is the product of two components: first, of sound-producing rhythmical air waves, created by the rhythmical movements of the vocal cords, and, second, while passing through the oral and nasal cavities, those rhythmical waves of air, or sound waves, undergo certain modifica-

Submitted for publication Jan. 3, 1955.

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* The human voice is produced during exhalation by means of the larynx, an organ consisting of cartilages and ligaments, situated at the upper end of the trachea and below the root of the tongue and the hyoid bone.

tions, called resonance.† The interplay between the sound waves produced by the vocal cords and their resonance is the eventual result which strikes the listener's ear. However, it has to be kept in mind that speech is the product of two functions, namely, phonation, or voice production, and articulation, or enunciation of the different speech sounds.

So far, whenever I have mentioned voice, I spoke of voice as it is used while speaking. However, voice is also a very important means to make music; voice is the essence of singing.‡ During speaking—communication—the meaning of what is said is the cardinal factor, and voice apperceived just as a means to an end, a kind of accompanying harmony to the main theme; the situation becomes reversed in singing. In this latter case, the voice by means of its musical qualities becomes the focal point. The melody produced by this voice becomes the center of attention, not the words on which the melody is sung. The words become a kind of pretext to permit a human being to sing. They are a concession made to rationality. Yet, very often the singing may be confined to a mere "la, la, la, la," and if the quality of the voice is pleasant and the melody reproduced to the listener's liking, he may enjoy it just as much as if some words were included. It will produce a similar effect on the listener as if he were listening to music played on some instrument. However, whether it is the concession the human being has to make to rationality, or because it is customary to do so, the greater enjoyment is encountered whenever words or meaning accompany the melody. Melody and words have to form, so to speak, a communication unit. One has to emphasize the other and, in doing so, what is called an artistic musical creation is achieved.

It would lead beyond the limits given to this study to go into a detailed analysis of what kind of enjoyment the production, reproduction, and listening to music created by singing consists. We know, although it does not concern us here, that the melody we come to hear and the words by means of which the melody is transmitted must follow certain laws in order to be enjoyed. We are here exclusively interested in the "qualities" of the voice, which while singing permits us in the first place to enjoy what we hear.

Dr. Fröschels used to say in his lectures § on voice: "What is supposed to be the physiology of voice is practically artistic production

† In "acoustic science" resonance means the prolongation or increase of any sound by reflection. It is the property of sonorous bodies to vibrate in unison with the vibration of other bodies and thus reinforce the original sound. As an example, the wooden body of a violin is the resonance box for the strings. Without its resonance body, the violin would be a very poor instrument indeed.

‡ Scheminsky, in "Die Welt des Schalles," [1] writes that there are no fundamental differences between singing and speaking. The technique of singing requires that the tone has to be kept a certain amount of time; as to speaking, the tone modulation is a gliding one and is not maintained on certain pitches. One of the main differences consists in the fact that speech uses tone variation constantly in various fashions; the tone variations in singing —as in Western music in general—consist only of discrete tone levels. For the expression of sentiments while speaking, constant tone variations are needed; yet it is without importance whether these variations are a quarter-tone higher or deeper. This is in contrast to musical interpretation, where definite tone intervals are prescribed and even small deviations are experienced as very annoying. In addition to these primary differences, one may observe less pure tones but more noise in speech, indistinct pitch during syllables devoid of accent, and much more liberty as to the speech rhythm.

Fröschels, in "Singen und Sprechen," considers the main difference between singing and speaking to be a prolongation of the vowel sounds. If one first speaks a word and then prolongs the vowel in the same word, speaking is transformed into singing.

In the author's opinion the difference is the following: Speech is confined to approximately six sounds at the lower level of the entire voice range. Singing can be done on two octaves and more. Speaking is constantly gliding between these six sounds deliberately chosen by the speaker. The singer has to maintain exactly the intervals prescribed by the song. Speech rhythm is determined by the mood and temperament of the speaker. The singer has to follow the rhythm of the song as requested by the composer.

§ These lectures were given in the early 30's in the "allgemeine Krankenhaus in Vienna," where Dr. Fröschels was the head of the clinic for voice and speech disturbances.

of voice." This statement presupposes that what one usually hears among average, untrained persons belongs already to the pathology of voice. What is, or rather what was, the criterion for this "physiology of voice or artistic voice production"? First of all, there is its beauty, its easy, equal emission throughout its entire range.‖ Furthermore, the singer must be able to make the best use of his resonance capacities, and must be able to make a smooth transition between the different registers.¶ The "piano" of the voice must carry just as well as its "forte." This means that all the sounds produced by the vocal cords, and by the vocal cords only, are a synthesis of air waves whose length and frequencies per second have a definite arithmetical relationship to one another.# If such an arithmetical relationship cannot be created, the sounds which come to the listener's ear lose their beauty and are evaluated by the human ear as noise. There has to be a certain happy arithmetical relationship between the length of the vocal cords and the walls which form the boundaries of the nasal and oral cavities in order that the latter may be able to serve efficaciously as resonance chambers.* Finally, the singer must be proficient enough to exhale only the amount of air needed to bring about the vibration of the vocal cords. If surplus air escapes through the glottic rim,† it clashes with the sound waves and thus interferes with their sound-carrying capacity. These above-mentioned physical qualities have to be present whenever the characteristics of the physiology of voice are described.

From the above description it is easy to see that in exceptional cases only one may discover a person whose voice has been endowed by nature with all those qualities of which, according to certain European standards, the physiology of voice consists. Whenever such a person was in possession of such a voice, he was the born singer. If, in addition, he was equipped with musical aptitude—which does not necessarily go hand in hand with it—he was the born vocal artist. However, it has to be noted that such a person has been always a rarity. Hence, whenever such a man or woman was discovered, he or she enjoyed the privileges of an extraordinary career in the musical world. The average singer, although a priori endowed with a pleasant voice, will be obliged to acquire the above-mentioned qualities by means of hard training. He will usually not be able to make the required smooth transition from one register to the other; he will have to learn to make the best use of his available resonances, and in most cases the sound-producing air waves will be spoiled by surplus air, which because of his poor breathing technique he is not able to prevent from escaping through his glottic rim. In addition, tension in the larynx, pharynx, or oral cavity may obstruct his tone production, so that his voice will become muffled, as if the singer were eating dumplings while singing. All this has to be eradicated by adequate training in order to prepare the singer to become a vocal artist. Whether the training will achieve its purpose is difficult to predict. Every year and for many years a great

‖ According to a table in F. Scheminsky's book, "Die Welt des Schalles," [1] p. 427, the human voice has an average range of two octaves. For example, the voice of the tenor ranges from B to b^1 (122.1 d.v. to 488.3 d.v.), that of the soprano from b to b^2 (244.1 d.v. to 976.5 d.v.).

¶ Scheminsky describes as register a series of tones which can be sung without changing the timbre of the voice. Those tones where a change occurs are called "Registerbruchstellen." The physiology of singing requires that no break should be heard from one register to the other. Altogether three registers are differentiated: chest register, middle register, and head register.

Scheminsky, F.: Reference 1, p. 443.

* The different parts of the "human resonance bodies" can only serve as resonators when the frequencies produced by the vocal cords correspond to their inherent capacity of reproducing certain frequencies. Therefore we speak of a happy relationship. Certain congenital deformities, a deviated septum, large tonsils, adenoids, polyps, and clefts of the palate may prohibit completely or distort the resonance qualities. Even without any obvious defects, the relationships in size may be such that the nasal and oral cavities can but serve as very poor resonators.

† During phonation the two vocal cords approach and form a very narrow opening to permit the passage of air. This narrow opening is called the glottic rim.

number of young people undergo such training here and abroad, travel to the famous centers of musical tradition in the hope that some renowned teacher will succeed in molding their voices into the shape which may enable them to become stars or at least members of the great opera and concert stages of the world. And here too it can well be said: "Many are called, but few are chosen."

All the characteristics, as described above, a voice has to have in order to qualify for physiologically correct singing are, however, a must only when its owner aspires to sing great opera or classical music. If he wants to limit himself to the realms of lighter music, to the musicale, and to the so-called hit songs, the requirements for voice qualities are less rigorous. Quite to the contrary, it very often happens that the performance of lighter music requires a manner of singing which is even in opposition to the physiologically correct voice production. Another influential factor which has put a modifying stamp on voice emission has been the laws of electroacoustics—in other words, voice undergoes certain modifications when it is transmitted by means of radio, television, records, wire, or tape.

The third factor and, in my opinion, a very decisive one is the artistic tradition inherent in a civilization, which affects the style of vocal music and varies its modes of expression.

Even Aristotle seems to have been aware [2] of preferences for a certain kind of voice among the art-loving ambisexual societies of ancient Athens and Rome. He mentions "certain methods which some singing teachers use" [3] to preserve the child-like character of a boy's voice. The first document on castration ‡ performed with the aim of conserving the boyish singing voice can be found in Dio Cassius (third century B. C.). Much later, during the Renaissance, singing castrates from the harem guards of the Moslem world were directed toward the choirs of Rome. Pope Clement VII was the first to introduce male sopranos into the church choir. Soon the Italians themselves took the knife ("coltello"), and in the 17th and 18th centuries approximately 4000 boys were annually "prepared" for singing careers. As late as the beginning of the 19th century, Duprez, who later became a famous French tenor, was threatened by the same fate, but his father rejected the "benevolent" proposition of his overzealous singing teacher.

The epoch of the castrati was vocally and musically a time of incomparable brilliance, and some castrati were given honors and financial rewards such as no singer received at any other time. The most famous of them was Farinelli,[2] who became an important member of the Spanish Court. His main function there was to soothe the melancholy of Phillipp V by his singing, just as in the Bible David had cheered up the depressed King Saul.

There are many exhilarating reports as to the beauty, the strength, and the sweetness of the male soprano voice, and in the 18th century most of the female opera roles were written for castrati. The last important male soprano, Domenico Mustafa, died in 1912.[4] In an article which appeared in March, 1952, in *Theatre Arts,* Basil Mitchell quotes a newspaper report from 1734 which describes the performance of a famous castrate singer. The opera he appeared in was "Artaserse," by Johann Hasse. "The sound filled the theatre, and there was a wonderful throbbing beauty in it. It was like the cry of a great, lonely bird, unrequited, yearning hopeless — yet serene."

The technical powers of these castrati were such that no voice today can undertake their repertoire. However, the extravagant love of music that made Italian stages so populous

‡ Castration means the removal of the sexual glands in a boy before he reaches maturity. The voice does not undergo pubertal change. Such castrates continue to grow up as boys, do not have any beard, become fat, and keep their soprano voices.

Castration inhibits the growing of the larynx; the lungs, however, grow to full maturity; the oral and nasal cavities, too, reach normal size and offer therefore much better resonance conditions than those which exist in the female body.

with these artificial voices would probably seem disgusting and even criminal today.

The practice was eventually condemned by Pope Benedict XIX in the middle of the 18th century. Yet, there is considerable evidence of such sopranos in Vatican choirs as late as 1920. Even today there are rumors that one can hear castrati voices in St. Peter's Cathedral.

Our new scruples have probably deprived us of a unique artistic experience. Much of the best vocal music by Mozart, Gluck, Rossini, and Handel would never have been written without the marvelous castrate voice as a performing instrument.

The bel canto style for the tenor voice, which Caruso best exemplified, is derived directly from the castrati.

It is said that the high financial reward was such an inducement that again and again aspirants for castration could be found.

The prepubertal voice, with its sweet and eery quality and its appeal of both urgency and innocence, made it precious to art-loving societies throughout the ages. In antiquity, the boy's voice was important for solo singing accompanied by the flute or the kithara. After the development of polyphonic music and the extended use of boys' voices in church choirs, the value of good voices was so great that the boys were extremely well paid and often abducted.[2]

Today the "Wiener Sängerknaben" and "Les Compagnons de la chanson" make concert tours through all of Europe and the U. S. A., and their concerts are evaluated by music lovers as incomparable artistic experiences. Although until the development of profane music the main concern was how to keep the boy's voice from changing, the modern concern is centered on the successful transformation of the boy's voice into that of the adult.

In contrast to the castrati, the boy's soprano voice is quite a natural phenomenon. However, in the case of the castrati, man has attempted to improve on nature with the help of methods our age rejects to being applied to human beings.

With the ascent of the modern opera, new styles of singing were developed which could cope with the demands on voice technique created by this recent artistic evolution. I happen to know that part of the rejection Wagnerian opera encountered in some countries was based on the objections that no singer's voice was resistant enough to endure the requirements put on it by a Wagnerian part. Immediate voice loss was predicted to every one who endeavored to sing such a part on the stage. The all-powerful guild of Italian singing teachers took exception that the traditional "bel canto" could not be applied while singing Wagnerian opera parts.§

When I came to the United States, I was struck by a style of singing, especially among female singers, which appeared to be in sharp contrast to what I was used to hearing judged as physiologically correct. It is the application of the chest register to tones which according to all investigations on singing should be formed by means of the middle register.‖ I have observed this style of singing in music which was ostensibly created by Negro composers or of music imitating American Negro music.

The female Negro singer seems perfectly at ease while doing this, and although the European listener rejects this style at first as somewhat savage or barbaric, in contradiction to everything he was brought up to regard as art in singing, he accepts the style later on with some fascination and pigeonholes the experience with those he had when first seeing African sculpture. He cannot but admire the virtuosity of the female Negro singer, who creates with her high tones sung by means of chest register quite peculiar effects. It is a technique that seems to require a virtuosity comparable to the bel canto style only.

§ The author got this information in her earliest childhood, when such problems were ventilated by her mother, who used to sing Wagnerian parts, and her friends, most of whom were musical experts.

‖ F. Scheminsky gives the change from chest to middle register for alto voices around d^1 to e^1, for mezzo-sopranos from d^1 to f^1, and for sopranos from f^1 to g^1.

Miss McKinn,[5] in a work on Afro-American folksongs, writes:

> It is difficult to express the entire character of these Negro ballads by mere musical notes and signs. The odd turns made in the throat and the curious rhythmic effect produced by single voices chiming in at different irregular intervals seem almost as impossible to place on the score as the singing of birds or the tones of an Aerolian harp.

In spite of the fact that white female singers copy this style of singing, I cannot but feel that the white singer applying this style does not feel comfortable doing it and does it in most of the cases to meet competition. She usually has to pay dearly for usurping this method.

Quite in contrast to the difficulty the white singer manifests by adopting the style of the Negro vocal music, the Negro singer seems to be perfectly at home and at ease while singing with chest register on pitches far above the conventional register change. The songs they sing are written to be sung in this special manner, and would completely lose their originality if somebody were to attempt to sing them in conformity with what was previously here described as the laws of vocal art. What fascinates me is the question how this special style of singing, quite in contrast to the European tradition, came into being. Many hypotheses are possible. It can, for example, be assumed that this is the more natural way of singing, and that the European style of singing applying the middle register is "artificial" and can only develop by means of a special method of training. It is possible. In this paper, I have alleged that female vocal art emerged rather recently in the evolution of singing. It replaced the childish voice of the choir boy and the voice of the castrati, which was nothing more than an artificial prolongation of the former, so to speak, ideal type. Could it not be possibly assumed that when women took over, when they had to replace the castrati, in order to do so they had to accept and to continue this ancient tradition and to propound a style of singing which was in contrast to their very nature. In reality every woman singer longs to sing with her chest register far beyond the f^1 of the alleged register change. I doubt it. I have seen too many white singers who suffered shipwreck when they adopted the method of dragging up the chest register. Another assumption of mine, although yet without scientific substantiation, seems to come nearer to empirical facts. Could it not be that the size of the larynx, the length and thickness of the vocal cords, and changed conditions in the nasal and oral cavities facilitate the singing with chest register among women Negro artists? As it has been just said, I have no means to validate my hypothesis by measurements, but if it should be correct, the style of the Negro singer would be physiologically correct, and her singing would follow those laws necessitated by changed physiological conditions. One would then be able to say that it was those anatomic and physiologic modifications which created the vocal style. However, still a third hypothesis is possible. F. Scheminsky[1] mentions that among Oriental civilizations (Arabs, Chinese, Indians, Japanese, Caucasians, Persians, Turks, and others) high nasalized tones are of special importance in their enjoyment of vocal art. Singing is inseparably connected with the use of high pitch. These peoples do not evaluate singing as singing if it is not done in the high and highest pitches. Lach ¶ reports that when he once asked a member of a certain Caucasian tribe why he did not sing with his ordinary chest voice, he received the answer: "With my ordinary voice? Every dog can do this." The use of the chest voice was considered as common to him as the barking of a dog. He never could have applied the term "singing" to such an ordinary occurrence.

This little story is just a side light to illustrate the differences in taste as to what may be appreciated in singing and regarded as vocal art among different civilizations. Can it not be surmised that the American Negro, who brought his musical tradition from the Western parts of Africa, and with it the style of singing now typical for the Negro female, regards just this kind of singing as his ideal of vocal art? Therefore he requires from his female artists this technique, although it is in

¶ Lach, cited by Scheminsky.[1]

contrast to what the European considers as the physiological correct method.

Fröschels, and with him the entire European school, is of the opinion that the physiological correct manner of singing as described in the previous pages is the only way of singing in which the vocal apparatus, especially the vocal cords, does not suffer any damage. Thus, the better the artist is capable of applying this technique, the healthier the conditions of his vocal apparatus will be. It is this technique, and this technique alone, which will preserve a person's voice throughout his life. If correctly produced, not one tone in the whole vocal range will be lost or suffer damage. Can such a claim also be made for other styles of voice production?

Yet, when the artistic vocal tradition emphasizes a certain way of sound production as beautiful, such as the singing of Negro female singers with chest register only, it is quite insignificant whether this singer is also qualified to sing other tones or with other methods which according to these traditions are artistically valueless. When a singer has to sing with chest register only, she will not care whether she loses the ability to sing with the middle register too, so long as she can continue to sing with chest register, the only style which is artistically appreciated.

Trouble starts when the poor vocal artist has to earn a living in a civilization such as the U. S., where two different vocal styles clash, and the singer has to switch from one style to the other. Then the white female singer will all of a sudden discover that while she painstakingly learned to sing in the Negro style, she has completely lost her ability to sing with middle register, a technique requested from her on other occasions. Not much can be done any more than to say with the poet [6]: "East is East and West is West, and never the twain shall meet." A white woman who has endeavored to sing with Negro technique, which means dragging up the chest register to regions supposed to be produced by middle register, will unfailingly lose the latter technique. This means that she will be unable to produce tones with the middle register and will have, so to speak, lost part of her voice.# Soon this loss will manifest itself in her speaking voice, which will become very deep, five or six tones below the normal pitch * of a woman's speaking voice, sounding husky and poor in resonance. Since as a white singer she was probably reared in a vocal tradition derived from the bel canto, she will be mortified by this loss. In addition, voice emission will not only became painful, but her entire vocal output will suffer so that eventually medical advice becomes unavoidable. Therapy will consist of voice rest, throat spraying with some emollient, and perhaps administration of antibiotics. All this will have no demonstrable effects. With much luck she may meet a doctor who may be aware that this singer has lost her voice not because something was wrong with her throat, but because she has established a vocal mechanism which ruined previously acquired vocal patterns. It is this doctor who will recommend vocal rehabilitation training. A great deal of "know how" is needed to reachieve the lost muscular coordination of the vocal apparatus essential to the singing of tones in middle register. The singer will have to make a choice between the two styles of singing if she wants to make the improevment a permanent one. Very often, especially when she is obliged to make a living by singing, she will nilly willy be forced to return to her former style, and the

Paul J. Moses [7] writes: "A trained ear is needed to diagnose the dread functional disease of the larynx, divergence of registers. No untrained ear can discover it, and immediate therapy and retraining is imperative. . . . The patient will complain of a loss of his middle range, while he sings easily in low and high ranges. (The middle range, or mixed register, is produced with the full width of the vocal cords.) The larynx usually does not reveal any visible pathology.

* The pitch of the speaking voice is on the lower end of the entire voice range. It will, for example, in an alto voice encompass the tones e to c^1. This is the so-called speech sixth. If it goes down to lower pitches, the range becomes identical to the speaking voice of a tenor (A to e) or even a baritone, whose speaking voice encompasses approximately the tones F to c.

vicious circle will start again until eventually the singer will be obliged to abandon altogether her career as a singer.

However, there is still another road open, and I have seen many professional white singers take it. She will make a virtue out of her defect. She does not care! Or she makes believe that she does not care. Rejecting her former voice pattern altogether, she adapts the style to serve all her needs.

Many a famous performer in this country has her greatest success shall we say because of or in spite of her poor husky voice. People call it "sexy." The husky voice of some of the famous Broadway and Hollywood stars gives the average listener or spectator a voluptuous shiver along his spine. The poor, ruined voice, often produced with agony by these actresses or singers, makes Mr. and Mrs. Babbitt dream of vices unheard of and gives them the illusion of delights reaching beyond the limits of human senses.

In the gossip columns of the tabloid newspapers, one can frequently find notes that one of the fashionable throat specialists has ordered complete voice rest for Mrs. T. B., or that one has discovered singer's nodes † on Mrs. K. H.'s vocal cords and that she will have to learn special voice methods to make them disappear.

Fortunately for these artists, only direct performances before an audience put so much wear and tear on the vocal organs of these actresses. Acting and singing for the movie screen, radio, or television can be performed in a way which requires not much effort of the vocal apparatus. The electroacoustic engineer can arrange things in such a fashion that only a minimum of voice contribution of the singer may produce a voice sufficient for public consumption. Frequently this is the voice refuge of the once-popular "Broadway star." ‡

Electroacoustics not only makes voice production easier for many artists, but has even produced vocal artists of its own. The "crooner" is such a typical product of electroacoustics. In most cases, the crooner would never have gained any prominence at all except for the modification his voice undergoes by means of electroacoustic rendition. The omission of certain frequencies, the reinforcement of others, can make all the difference in the voice of a singer and may artificially create effects very pleasing to the ear, although the singer's natural voice, without the alterations induced or made possible by electroacoustic rendition, is just average and devoid of any outstanding characteristics. However, when once the singer has become famous with the help of an electroacoustic medium, he can easily venture to sing in a concert, in a show, or in a night club without the help of electroacoustic modifications. The halo of his fame will cover up any defects which may appear through direct interpretation. I remember that in the early 30's a so-called "whisper tenor" appeared on the Viennese radio. His voice was discovered to be ideal for radio transmission although it had been a complete failure in the concert hall. He represented that style of singing which in the U. S. is called a "crooner," and people, especially female teenagers, raved about him. When his success as a radio crooner was firmly established, he had the artistic ambition to give a serious concert in one of the big concert halls in Vienna. Not only was the hall sold out, but his fans gave him a great ovation. The critics, too, who had condemned him originally, had to concede that Mr. S., although lacking a strong voice, possessed certain artistic qualities much in demand and highly appreciated in our technical age. I also remember a woman whose little voice and poor appearance (she was hunchbacked) made her impossible for the stage, but who was discovered as having a very pleasing voice on records. Few who ever heard her sing "Maybe I Loved You Too Much" and "Stormy Weather" will ever forget the haunting appeal of disappointed love as expressed by the singer through the medium of recording. A year later we were

† Singer's node is a condition marked by the formation of a small whitish nodule on one or both vocal cords.

‡ See page 53 of this paper.

able to hear this singer in a night club. Since she was already very famous as a record singer, the "mis en scène" was very carefully arranged to hide her defect. Her voice, however, was very disappointing, the charm and the appealing qualities being completely lost in direct transmission. In spite of all this, all those who had learned to love her through her recording maintained the illusion of a great success.

SUMMARY

A physiologically correct way of voice production coincides with what is regarded as beautiful according to European taste; this method of singing has had in Europe an ancient historic artistic tradition. Interestingly enough, this tradition derives from a pathological phenomenon, the castrato, who was during two and a half centuries the standard bearer of European vocal art.

However, the European style of singing is not necessarily regarded as artistic singing among other civilizations. As long as these other civilizations remain isolated and without much foreign artistic influence, they may develop a style of singing which, although not accepted by European taste, represents the unified artistic vocal expression of their own civilization.

When these styles do not remain isolated, as in the United States, one can observe the phenomenon of two opposing artistic styles in a clash. Thus the European and the Negro style compete, and, by doing so, life for the white vocal interpreter becomes rather difficult. Whereas the female Negro singer is perfectly at home in the Negro style of singing and only exceptionally endeavors to sing in bel canto tradition, the white singer, while attempting to become efficient in both styles, loses her voice altogether. Some of these artists, being very much liked and successful, have attempted to create, by means of their husky ruined voices, a style of their own.

Since this new way of voice production—I do not believe that it still can be called singing—harvested great success, especially with the American public, it somehow succeeded in creating a new fashion, a fashion copied even by vocal performers who have not lost their voices. (By doing so, they certainly accelerate the process of demolishing their vocal capacities.) At first, it was just a substitute voice, replacing an impaired function; later it became, and still is, an accepted style of vocal art. Yet it has to be admitted that this style is a direct adaptation from the Negro vocal tradition. Sociologically it has to be explained as a kind of phenomenon where one of the specific cultural patterns belonging first to a minority has not only been accepted but even became the dominant pattern of the majority.

The new inventions of electroacoustics, on the other hand, were able to make popular a certain kind of vocal art which without this medium would probably have never gained much attention. The special laws of electroacoustics were incidental in the promotion of the crooner and gained an audience for the "husky" singer, who without these new media would have been probably obliged to rescind the career as vocal artist altogether.

Thus it can be concluded that the new style of vocal art which has, so to speak, been an offspring of the Negro singing style would never have been able to win such popular acclaim without the inventions of a series of electroacoustic machinery. It has to be kept in mind that this new vocal style is the result of a sociological phenomenon facilitated by the technical inventions in the sphere of electroacoustics.

444 E. 58 St. (22).

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Ménière's Disease, Cochlear Type

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The cochlear type of Ménière's disease was described by Brunner.[1] Deafness was the cardinal symptom, and there was no history of any vertiginous attack. Williams and associates [2] reported a number of cases of endolymphatic hydrops without vertigo. Their diagnosis was based on a history of an allergic background, a fluctuating low-tone hearing loss of sudden onset, and diplacusis. As a confirmatory therapeutic test, these authors cited the favorable results they obtained from the administration of histamine.

The audiologic study of Ménière patients during the past 12 years yielded some interesting results. The Ménière cochlear function seems to be encumbered with numerous pathologicophysiologic details. These are revealed in relation to tonal perception, selective hearing, threshold of discomfort, and intelligibility of speech. To be sure, the great majority of my patients presented the complete symptom complex of vertigo, deafness, and tinnitus. The aim is to gather the facts that make the Ménière cochlear function unique so that when this type of perceptive impairment without vertigo is encountered it may be readily identified as endolymphatic hydrops. The audiologic characteristics will be described, and an illustrative case report will follow.

AUDIOLOGIC CHARACTERISTICS

1. Poor speech hearing in spite of a favorable audiogram and a suitable hearing aid. The Ménière patient, who presents a deafness problem, has a bilateral involvement with a 40 to 60 db. impairment, and his hearing-loss curve is usually, more or less, flat across the board. Without a hearing aid, he cannot hear and, frequently, the distortion due to diplacusis makes one ear entirely unreceptive to meaningful sounds. Most Ménière patients obtain some benefit from a hearing aid when speaking to one person, but in group conversation, intelligibility is diminished. There appears to be a reduction in capacity for selective hearing, the patient complaining that he gets confused when several sounds come in through his hearing aid. In an occasional case, there is a shrinkage in the range of speech hearing due to lowering of the threshold of discomfort. At 75 db. intensity, a word becomes intelligible, and at 80 db., it is too loud and intolerable. Dix, Hallpike, and Hood [3] reported absence of speech intelligibility. This was encountered only occasionally by me. The great majority retain considerable speech intelligibility and are partially benefited by a hearing aid and by auditory training.

2. Low threshold of discomfort.

3. Recruitment and hyperrecruitment. A diagnostic specification in Ménière's disease is the presence of recruitment, as pointed out by Dix, Hallpike, and Hood.[4] Hyperrecruitment may be an illusion, the sound appearing louder to the Ménière ear because of its low threshold of discomfort. According to Lorente de Nó,[5] the degeneration of a number of hair cells or cochlear fibers causes an impairment of hearing of weak sounds, but strong stimuli bring about adequate saturation of the cochlear nuclei, by way of the remaining healthy fibers, so that a tone of great intensity is perceived with the same degree of loudness in the diseased ear as in the normal one. Lurie [6] hypothesizes that the inner hair cells function in the re-

Submitted for publication Dec. 16, 1954.

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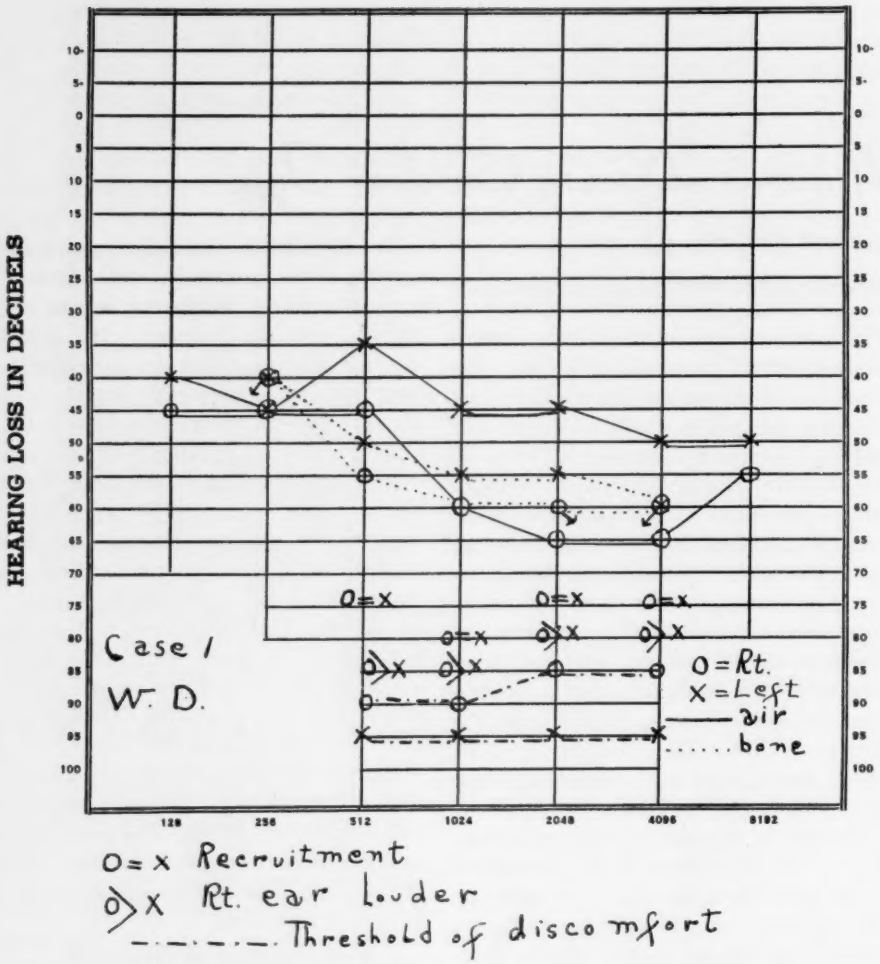

ception of sounds at the 30 db. level or louder, while the outer hair cells, which become involved in a degenerative process most frequently, are concerned with sounds of minimum audibility. Therefore, tones of increased intensity will sound just as loud in the diseased ear as in the normal one as long as the inner hair cells are not affected. Either one of these two theories explains the recruitment phenomenon satisfactorily, but neither of them supplies any ground for a physiologic basis of hyperrecruitment.

4. Poor bone-conduction hearing. The decrement extends throughout the frequency range, and in 40% of the cases the 256 cps tone is not heard at all by bone conduction at the highest intensity of the audiometer. In view of the moderate pure-tone loss by air conduction, the curtailment of bone-conduction acuity in Ménière's disease is proportionately greater than in other forms of perceptive deafness of different etiology.

5. Diplacusis. Frequently, the lower tones are affected, but diplacusis may prevail throughout the frequency scale or predominate in the higher range. The distinctive feature of diplacusis in Ménière's disease is its tendency to deprive one ear of speech intelligibility. Frequently, in the higher-pitched ear, the sounds are not readily con-

verted into meaningful patterns. However, usually the result is a reduction in intelligibility, while total ablation is rare.

REPORT OF A CASE

W. D., white man, aged 52, came under my care on April 27, 1950. His first vertiginous attack occurred in May, 1948. Tinnitus and impairment of hearing in the right ear became evident about the same time. Vertiginous attacks recurred at irregular intervals. After a severe episode of vertigo in September, 1949, the hearing in the left ear became impaired. Tinnitus with high and low pitched components was present in both ears. Otoscopy and direct nasopharyngoscopy disclosed no abnormality. There were no abnormal spontaneous neuro-otologic phenomena. The caloric test yielded delayed and hypoactive responses from both ears, but they were normal as to nystagmus, falling, and past-pointing. The Figure is this patient's audiogram. His low threshold of discomfort and his poor bone conduction, which was nil for the 256 cps frequency, are charted.

The most outstanding audiologic findings were the poor speech intelligibility and the inability to exercise selective hearing. In the right ear, amplified speech was rendered unnatural and unintelligible due to the diplacusis with a change in pitch to a higher range. The hearing aid on the left ear was of some benefit in speaking to one person, but in group conversation and in the presence of noise "confusion" ensued. All sounds came through the hearing aid at the same time. While selective hearing is a cerebral function, it is probable that the Ménière organ of Corti is too hypersensitive, permitting extraneous sounds to register unduly. The mechanism of the speech hearing "confusion" is of the nature of peripheral masking.

SUMMARY

Audiologic phenomena in Ménière's disease are presented. These findings may be utilized in the diagnosis of the cochlear type of Ménière's disease.

1923 Spruce St. (3).

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Complications of Postnasal Packing for Epistaxis

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Postnasal packing has been an accepted method in the management of epistaxis for many years and is widely used. It is often effective in instances of severe bleeding, especially from the posterior part of the nose, that are not controlled with anterior packing, spot or precision packing, cautery, and other simple measures. The usual methods have been described many times, and are a part of nearly every physician's training.* The purpose of this report is to describe certain complications and disadvantages of the usual methods, to discuss the principles involved in their use, and to bring further attention to a method that avoids these disadvantages and more logically fulfills the principles involved.

THE ORDINARY POSTNASAL PACK

The usual postnasal pack is a single large mass of gauze, cotton, air-filled rubber, or other material, which is of such size as to fill the superior nasopharynx snugly. It is maintained in position by constant traction on attached strings that have been brought forward through the nose and fixed in front of the nose by various means. The pack usually covers the orifices of the Eustachian tubes and lies on the superior surface of the soft palate. It extends inferiorly in a varying manner, but laterally, superiorly, anteriorly, and posteriorly it usually extends to the corresponding wall of the nasopharynx. Thus, in essence it is a nasopharyngeal plug held in place against the posterior nasal orifices. As such it does not enter the nose, and can serve only one function in epistaxis, namely, to close the choanae tightly. This is the type of postnasal pack that may be used in severe hemorrhage following adenoidectomy but not for nosebleed. This type of pack occasionally causes complications, examples of which follow.

Laceration of the soft palate is illustrated by the following two cases.

CASE 1.—A 65-year-old woman was seen on Dec. 20, 1946, because of intermittent epistaxis that she had had for seven days. A postnasal pack had been inserted several days before. Examination disclosed a painful and infected laceration at the junction of the uvula and the soft palate which had been caused by a tight string passing from the pack out through the mouth.

CASE 2.—A 75-year-old woman was seen on Jan. 18, 1948, because of nosebleed on the right of four days' duration. A posterior and an anterior nasal pack had been placed in the nose the day before. There was a painful deep laceration of the right palate that had been caused by the tight string that extended from the pack out through the mouth. This string had practically bisected the soft palate.

Laceration of the nasal floor is illustrated by the following case.

CASE 3.—A 78-year-old woman, seen on Nov. 19, 1954, had been bleeding from the right side of the nose for seven days in spite of repeated packing. The present postnasal pack had been in place for four days. There was no string hanging posteriorly and removal was difficult, as the large pack was firmly wedged into the nasopharynx. There was a painful, infected laceration 1 cm. long on the nasal floor in front.

Hemotympanum is illustrated by the next two cases.

Submitted for publication Feb. 25, 1955.

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* References 1 to 5.

CASE 4.—A 42-year-old man, seen on Aug. 24, 1947, had been bleeding from the right side of the nose for 10 days in spite of repeated packing and 10 or 12 blood transfusions. Anterior and posterior packs were in place. Examination showed that both tympani were filled with dark blood.

CASE 5.—An 18-year-old girl, seen on May 28, 1954, had been bleeding profusely from the right side of the nose for four days in spite of repeated packing and 18 or 20 blood transfusions. Examination showed that both tympani were filled with dark blood.

Edema of the larynx and pharynx is illustrated by the following case.

CASE 6.—A 69-year-old man, seen on Dec. 23, 1953, had had massive epistaxis from the right side of the nose one month before, followed by six recurrences, all of which had been treated by multiple packings and transfusions. He had undergone ligation of the right external carotid and right anterior ethmoidal arteries. Three days before arrival a tracheotomy had been necessary because of obstruction of the airway caused by increasing pharyngeal and laryngeal edema that had occurred in spite of the fact that three weeks had elapsed since the carotid ligation and two weeks since the ethmoidal ligation. Examination disclosed fluid and blood in both tympani and edema of the pharynx that was still marked. The following day the posterior pack was removed. It was wedged very tightly and filled the whole nasopharynx. There was no posterior string, and removal of the pack was difficult and painful.

In all these instances, the pack was of the large nasopharyngeal type. Other complications, which have been observed by many others as well, include suppurative nasopharyngitis and otitis media. There is at least one reference to the occurrence of tetanus following use of such a pack.[6] Spar and Williams reported a case of osteomyelitis of the basisphenoid and basiocciput with meningitis and palsy of several cranial nerves that followed the use of a postnasal pack for epistaxis.[7] In addition to these complications, a large postnasal pack causes severe pain nearly always, renders nasal respiration impossible, and makes swallowing nearly impossible and very painful.

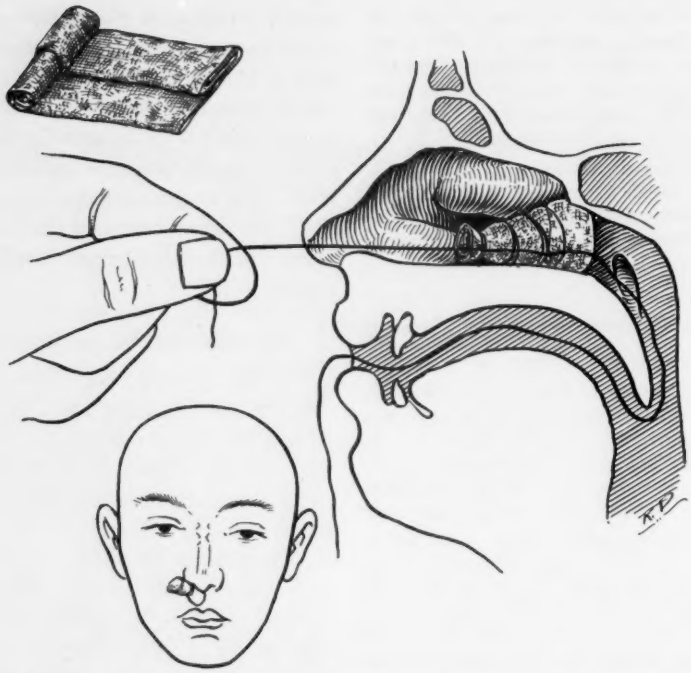
There is only one principle involved in use of the postnasal pack that fits flush against the posterior edges of one or both choanae and lies entirely in the nasopharynx. Such a pack serves as a closed door to the back of the nose, and thus converts the nasal cavity into a closed pocket, open only forward, which may then be snugly filled from the front. This allows the anterior pack to exert effective lasting pressure against the bleeding area. It is emphasized that it is the anterior pack that exerts pressure, the posterior pack being unable to cover any bleeding point in the nose.

THE CONE-SHAPED POSTNASAL PACK

Various types of packs have been devised that seal the posterior nasal orifices just as effectively as does the type just described but that do not extend into the nasopharynx more than several millimeters; such packs may be used to seal only one choana—the one on the side of bleeding. These packs are cone-shaped, with the apex forward, and the area of the base is slightly larger than the area of the choana to which the pack is to be applied. When the pack is inserted, forward traction is used so that the apex enters the choana, the part of the pack just forward of the base becoming "stuck" in the choana.

Of the several cone-shaped packs described,† the simplest seems to be the one of Dickie (see Figure).[10] This consists of a strip of gauze 2½ or 3 in. wide that is folded lengthwise an inch from one edge and then is rolled up tightly so that one side forms an end that is much thicker than the other. When the thick end is about ¾ in. in diameter, the surplus gauze is cut off and the pack is bound tightly around the middle with string, the ends of the string being left long. The ends of string are then wound crisscross around the small end and tied tightly. The roll is now cone-shaped, with the strings attached to the small end. Another piece of string is tied to the base of the cone. The size of the pack may be varied by cutting off portions of the base end, and thus made to fit any choana. A rough guide is to make the diameter of the base end the same as that of the distal phalanx of the patient's thumb.

† References 5, 8, and 9.



Method of applying postnasal pack. (Reproduced from Hallberg, O. E.: Severe Nosebleed and Its Treatment, J. A. M. A. **148**:355-360 [Feb. 2] 1952.)

The cone-shaped pack is inserted in the usual manner: A lubricated catheter is passed through the nose and out through the mouth, both of the anterior strings of the pack are tied to the catheter, and then the catheter withdrawn back through the nose. Gentle traction on the strings through the nose is used to pull the pack into the nasopharynx, and then the pack is snugged into the choana, with the index finger being used in the nasopharynx to get a good fit and to check on the amount of pack protruding into the nasopharynx. If there is considerable protrusion, the pack should be removed and reshaped, and then reinserted. A coating of petrolatum (petroleum jelly) on the pack makes insertion easier and less damaging to the mucosa, and permits easier removal later. Traction is maintained by use of the two anterior strings that are tied over a piece of tubing or dental roll. Moderate pull must be provided. The string passing into the pharynx may be cut at the level of the base of the tongue or brought out through the mouth and taped loosely to the cheek. Use of this string makes removal of the pack simple and nearly painless. This string must not be tight; if it is, swallowing will cause it to cut the soft palate. The pack may be left in place up to a week without serious sequelae.

The cone-shaped pack has several advantages over the usual large nasopharyngeal pack. 1. It permits leaving the opposite side of the nose open, thus allowing some nasal breathing. 2. It produces less pain than does the large nasopharyngeal pack, because the total area of contact between the pack and the mucosa is much less and the walls of the nasopharynx are not touched. 3. It usually permits painless swallowing, as the pack does not touch the soft palate. 4. It is less likely to cause the complications of hemotympanum and otitis media, as it does not cover the Eustachian orifices. 5. It is less likely to cause suppurative disease of the nasopharynx and nose, because good drainage is available for all of the area except one nasal cavity.

6. Because of the snugger fit, it produces a better closure of the posterior nasal orifices than is produced by the large nasopharyngeal pack. 7. It can exert direct pressure on a bleeding point in the nose near the choana, which is not possible with the larger pack. 8. It is more easily removed than the larger packs. 9. It may be made of simple materials that are available wherever and whenever epistaxis must be treated. 10. It may be left in place longer than the large pack because of the lessened opportunity for infection and other complications to develop.

SUMMARY

Certain complications may follow the use of the ordinary postnasal pack for the control of epistaxis. Among these are laceration of the soft palate or the nasal floor, hemotympanum, and edema of the larynx and pharynx. The likelihood that such complications will occur may be reduced by the use of some type of cone-shaped pack, which permits unichoanal corking.

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Audiology Section

DR. JOSEPH SATALOFF, ASSOCIATE EDITOR

Recruitment, Pitch Tests, and Speech-Tone Hearing Discrepancies

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The concept of the audiological team, as envisaged by Canfield,[1] has proved a powerful tool in attacking a variety of problems in the borderland between otology, experimental psychology, and the psychophysiology of speech communication. The otologist, burdened as he is with an overwhelming sense of medical responsibility for the patient, a responsibility which at any moment can become a matter of life and death, cannot afford to consider the patient's problem in the abstract, apart from the patient's well-being. Nor can the otologist for practical reasons take the patient's and his own time for extensive psychophysical testing, much of which would of necessity be exploratory and irrevelant to the questions of diagnosis and treatment. On the other hand, the speech communications engineer, or the psychologist interested in, for example, loudness scaling or the integration of energy in short pulses, certainly cannot afford to overlook the medical aspects of the ears he inserts into his system or uses in his experiment.

It is often said that whereas the 19th century was one of specialization in science, the 20th century is turning toward synthesization, as witness the trend toward general science courses in our colleges. But while there is certainly nothing inimical in the medical *vs.* the psychological approach to the patient, nevertheless very few men combine within themselves a competence in both spheres, and so teamwork becomes the key to the synthesization we seek in the area of audiology.

Our own experiences, we feel, confirm the usefulness of Canfield's concept of the audiology center. We cannot, however, agree with some workers that there is a "science of audiology" for work in which persons can be trained. The area of audiology encompasses some part of several sciences, and no one man can become expert in all. To teach "audiology" as a separate science is, after all, to violate Canfield's concept of teamwork. We have found, for example, that it is better to staff our own laboratory, about a dozen members devoted to broad problems in the psychophysiology of hearing, with classically trained physicians, physiologists, psychologists, biochemists, and communications engineers rather than with persons all given approximately the same training in audiology. This method seems to produce vastly more cross fertilization and breadth of thought within the audiological team.

It is with some such thoughts as these in mind that we have made bold to attack a variety of problems in audiology. This paper reports our experiences with one of these problems. We addressed ourselves to that most perplexing question, namely, why it is that some ears can hear pure tones at a certain intensity but are relatively poor at hearing speech. Apparently, even when one rules out cases with aphasia, bilingual language difficulties, retarded mental development, or other personality attributes possibly affecting efficient speech reception, there remain still some persons who exhibit a real discrepancy between hearing for speech and for pure tones.

Submitted for publication Nov. 5, 1954.

From the U. S. Navy Medical Research Laboratory, Submarine Base.

The first experimental insight into this problem was by Dr. Fowler Sr.,[2] who felt that the threshold audiogram was in some ears not sufficient information with which to forecast speech reception ability, and he proposed a correction factor [3] based upon the ear's recruitment performance. We,[4] among others, fully examined Fowler's suggestion, and concluded that, while recruitment for pure tones in an ear would certainly also affect the loudness of speech in that ear, there was not necessarily a simple relation between the loudness of speech and its intelligibility (for a full account, see Harris [5]).

It seemed to us at the time of our previous report that some other psychoacoustic phenomenon in addition to loudness distortions must explain the speech-tone hearing discrepancies which we were encountering from time to time and which we were unable to explain to our satisfaction.

Since the psychological characteristics of a continuous pure tone are fairly well, though not fully, specified by its pitch and loudness, we sought for the source of the speech-tone discrepancy in the pitch-handling capacity of ears known to be discrepant.

Our population was a group of 26 ears from 22 men and women, all partially deafened, referred from several sources to this laboratory for hearing testing. Impairment in five ears was purely or heavily conductive. All the testing was performed with well-calibrated clinical apparatus by Myers, except some of the pitch discrimination work, which was done by other members of the staff.

The C. I. D. W-22 Phonetically-Balanced (PB) lists of monosyllables were given, a complete articulation curve being drawn for each patient. Speech-hearing loss was taken to be the voltage difference, in decibels, between the 50% intelligible points for the patient and for a group of normal-hearing ears.

Audiograms, both bone- and air-conduction, were collected for both ears of all patients; the experimental ear was examined as to presence of recruitment, also as to rate and type of recruitment; pitch discrimination was tested as described below; a complete background history was collected of all factors likely to have affected the ears, and, finally, an otological diagnosis was written.

An ear was labeled as discrepant between speech hearing and pure tone hearing on the basis of the PB score *vs* four different ways of compressing the audiogram:

(1) An average of loss at 500, 1000, and 2000 c/s

(2) The current A. M. A. system of computing, multiplied by 1.2 to convert percentage loss into something comparable to absolute loss in decibels

(3) Fowler's 1947 system,[3] also multiplied by 1.2

(4) Fletcher's 1950 system of weights.[6]

If three or more of these systems underestimated the speech loss by more than 5 db., that ear was labelled discrepant; the same, if the loss was overestimated, provided that the three systems agreed on the direction of misestimation. There were eight ears for which all four systems pretty well agreed with the PB score, and these ears were labelled nondiscrepant. There were eight ears for which no system (or at most, one) hit within 5 db., but two systems were in the direction of estimation not shared by the other two systems. In this contradictory situation the information was thought not definite enough to label the ear as discrepant.

There remained, then, 10 ears for which a definite discrepancy did exist between hearing for speech and for pure tones. Three of these ears had conductive impairment; two were mixed, and five were perceptive.

The total population was again divided on the basis of whether pitch discrimination had deteriorated. Each ear was tested by the method of constant stimulus differences [7] at some frequency in the auditory area for which the ear was partially defective, at a loudness approximating that necessary for speech intelligibility. The differential threshold was compared with that for the other ear at some frequency, preferably the same frequency, for which the other ear was normal. Very careful loudness balancing was done between the two ears, and pitch data were always collected at equally loud intensities;

this precaution is a vital one.[8] In some cases a different frequency was used either in the same or in the other ear, depending upon where a normally-heard frequency was available. With differing frequencies, a correction was applied based upon previous data on normal ears.[9] The availability in at least one ear of a normally heard frequency located in the speech range was, indeed, the main criterion for including an ear in this study. Selection was otherwise on irrelevant bases, depending largely upon whether the patient could remain or return for the very considerable time needed for adequate pitch discrimination testing.

Five ears showed pitch deterioration very clearly at speech frequencies and at intensities involved in that ear's speech interpretation. Two more ears showed some deterioration of pitch, but not unequivocally. The other ears often showed some deterioration, relative to their normal controls, at the weaker intensities but recuperated completely at the intensities significant in handling speech. We do not consider that these ears are pitch-defective in handling speech. Some ears showed no deterioration at any intensity.

A further dichotomy was at hand, as to whether recruitment existed; the test was usually binaural, but a few monaural balances at differing frequencies were done in ears for which that technique was most appropriate.

With these data, it was possible to attack the perplexing interrelations of loudness perception, pitch discrimination, and speech-tone discrepancies in hearing.

In the first place, it is clear that no simple relation exists between any two of these three variables.

1. Pitch deterioration by itself explained not a single case of speech-tone discrepancy.

2. Of those ears with recruitment, all with perceptive or mixed involvement, some show great pitch deterioration, others none; some show clear speech-tone hearing discrepancies, others no discrepancy.

3. Of those ears with speech-tone discrepancies, some are perceptive, some mixed, some conductive; some show quick and complete recruitment, others no recruitment, but only two ears with deteriorated pitch had speech-tone discrepancies, and these two had the least pitch deterioration of the seven in that subgroup.

4. Of those ears with pitch deterioration, the five most affected had complete recruitment and all were of the perceptive type of deafness. But in spite of these severe distortions of auditory cues, both for pitch and for loudness, which one would think would certainly affect speech discrimination, none of these five had any speech-tone discrepancy.

5. The other side of the coin also held true, with ears of normal pitch discrimination but with recruitment also. There were seven such ears, and all showed real speech-tone discrepancies.

The direct question whether poor pitch discrimination per se contributes to poor speech reception must then be answered in the negative. Within our own laboratory we have stimulated an ear with a 750 cps tone at 140 sound pressure level for two minutes, a blast which depresses a Bekesy-type audiogram about 25 db. through the speech range for half a day or more. In one subject this blast caused a deterioration from her normal differential threshold of 3 c/s, to about 15 c/s, at the loudness needed to pick up 50% of spoken monosyllables; yet her speech reception was not affected beyond what would have been predicted from an average hearing loss at 500, 1000, and 2000 c/s. It seemed evident to us that speech contains enough frequency redundancy to overcome a quite considerable blurring of speech cues. Looking back, we can now see that that subject represented another case of severe loudness-plus-pitch-distortion, without any speech-tone discrepancy. There is, in summary, no evidence, to our knowledge, that pitch deafness of itself contributes much to speech blurring.

The problem thus becomes one of covariance of pitch and loudness. There are plenty of cases in this series, of recruitment without pitch deterioration, which do show

real speech-tone discrepancies. But all five cases of recruitment with clear pitch distortion added show no discrepancies. It is as if the presence of one type of distortion (loudness recruitment) is enough of itself to reduce speech intelligibility, but the presence of both types of distortion compensates in some way such that speech is undisturbed beyond what would be generally predicted from the threshold audiogram alone.

Now, what could be the nature of this so-called compensation process? It is logically possible that it is not truly a compensation but merely an artifact of type of deafness. Let us suppose that some types of disorder lead to recruitment but not to pitch deterioration but that some types lead to recruitment plus pitch loss. If so, a third factor, such as locus of lesion, could enter the picture and disturb speech by, for example, temporal distortion. In that case no real compensation device between pitch and loudness need necessarily be assumed.

When, however, we come to examine the otological description of those five ears in which recruitment and clear pitch loss coexist, no especial pattern appears. Recruitment quick and complete is the rule, and of course all disorders are labeled "perceptive," but diagnosis ranges over familial, toxic, and traumatic causes, while the audiograms show a great variety. Two have a high-tone loss sloping off 20 db. per octave; one has a sharp drop of 50 db. per half-octave starting at 1500 c/s; one has a 50 db. dip at 2000 c/s returning to normal symmetrically at 25 db. per octave, and one has a saddle-shaped audiogram broadly through the speech range. No trends certainly are apparent here. Furthermore, in the rest of the ears in this study there are numbers of cases which show quick and complete recruitment, which have similarly shaped audiograms, which are familial or traumatic in etiology, and in which speech is further distorted.

We are forced to conclude, in the absence of a finer diagnosis, that the speech-tone discrepancies we note here are not the result of the type or types of deafness per se. Of course it remains logically possible that were one able to break down into finer categories the broad diagnostic phrases universally used in otology one might be able to use the covariance of pitch and loudness, plus the lack of any speech-tone discrepancy, as aids in diagnosis. But one cannot assume this will come to pass, and in the meantime we still have the facts to be accounted for.

We can at once dispose of the notion that in all cases of recruitment there will be pitch deterioration. Schubert,[10] for example, has published a case of pitch deterioration in a perceptive deafness of traumatic origin. Both pitch and loudness are distorted, but no mention is made of the patient's ability to hear speech. Schubert thinks it likely that "an increased sensitivity with respect to loudness is therefore possible only on the basis of paying the price in the form of decreased pitch discrimination, and conversely." *

Zwicker and Kaiser,[11] using practically the same frequency-modulation technique as Schubert, report one case of perceptive deafness in which pitch deterioration was found through that portion of the auditory area affected by the disorder. Zwicker [12] later showed that this same patient had a pitch-deterioration pattern very similar to that of a normal-hearing observer masked by a band of noise in the high-tone region; we assume that the patient had recruitment. Unfortunately for our present purpose, this patient was not examined as to his hearing for speech.

Our data, however, make it clear that recruitment of any type, even quick and complete with overrecruitment, can occur without any pitch deterioration whatever. Of the 15 patients who did not show pitch deterioration, 6 showed quick and complete recruitment; the others showed delayed recruitment (4 cases), or had cases of purely conductive or heavily conductive mixed deafnesses and showed no recruitment in our tests (5 cases).

All of our data thus point to the conclusion that, although there is no necessity for

* Dr. Andrew Pikler translated this article.

every case of recruitment to be accompanied *pari passu* by pitch blurring, some of recruitment's unfortunate effects on speech reception are alleviated by concomitant pitch deterioration.

Rather in the spirit that the investigator is called upon to furnish hypotheses for his own data than in any spirit of confidence, we propose a suggestion in terms of the elemental auditory building blocks composing the whole auditory area. An elemental building block would be bounded on one side by a just noticeable difference (jnd) in intensity and on the other by a jnd in pitch. Suppose a jnd for intensity of 2 db. and a jnd for pitch of 2 c/s, at some region in the whole auditory area. A small physical area enclosed by 10 db. and 10 c/s would then be composed of 25 (10/2×10/2) elemental auditory blocks, with which to interpret sounds in that small physical area. Now suppose the jnd's were changed to 1 db. and 4 c/s by recruitment and pitch blurring. There would still remain 25 (10/1×10/4) elemental blocks with which to interpret the sounds in that same physical area, and speech in that area would be undisturbed. The further corollary would be that improving the jnd for intensity to 1 db. without also changing the pitch jnd would create 50 (10/1×10/2) blocks, and in this case we exceed to an inefficient degree the information-handling capacity of the organism.

However this anology may be, it is clear what line future research should take. It will probably not be useful to study by itself, as a possible diagnostic sign, the pitch capacities of an ear. It is more likely that the intimate relationships among the four variables of pitch, loudness, speech-tone discrepancy, and type of deafness will repay further study. But it will probably be the interrelationships, rather than isolated variables, which will prove of theoretical and practical importance.

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Case Reports

RECURRENT SUPPURATIVE MEDIASTINITIS EIGHTEEN YEARS AFTER THE INGESTION OF A FOREIGN BODY

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INTRODUCTION

FOR A PATIENT to survive a perforation of the esophagus and a subsequent suppurative mediastinitis in the prechemotherapy and preantibiotic era was a near-miraculous happening. This is the tragic report of a girl who did just that, only to develop a recurrence of the mediastinal infection 18 years later. This time, in spite of all the modern antibiotic agents and surgical techniques, she never recovered from the complication.

The case is presented in elaborate detail because of its many challenging facts, which at one time or another involved nearly every surgical specialty as well as internal medicine and psychiatry. Furthermore, the patient's sudden demise and the unexplainable gross anatomic findings at autopsy made this a most thought-provoking clinical problem.

REPORT OF A CASE

A 19-year-old white female college student had been in good health until one week prior to Oct. 3, 1952. At that time she was seen by me at her home complaining of generalized aching, difficulty in swallowing, and sometimes an actual sore throat. She had been seen the week previous by her internist, who had prescribed sulfisoxazole (Gantrisin). This had resulted in temporary relief, but the symptoms recurred immediately upon the cessation of the drug. The patient was found to have very little redness of the pharynx, a moderate amount of redness of the hypopharynx, tenderness especially along the anterior border of the sternocleidomastoid muscle bilaterally, but no stiff neck. The temperature was 100.2 F. Otherwise, the examination was negative. The patient was given penicillin and chlortetracycline (Aureomycin) in combination. A throat culture was taken.

On Oct. 6, the throat culture was reported as being positive for diphtheria and the patient was admitted to the hospital for further studies. The most likely diagnoses were at this time considered to be infectious mononucleosis or diphtheria. The patient had never had any immunizations, because the father "did not believe in them." Her white blood cell count on admission was 14,500 with 85% polymorphonuclears, and the throat smear again was reported to show pathogenic Corynebacteria. She was given 70,000 units of diphtheria antitoxin plus 10 cc. immune globulin and transferred to the Communicable Disease Unit of the Los Angeles County General Hospital.

On Oct. 8, all the usual agglutination tests were reported as negative, as was a blood culture. The hemoglobin was 69%, erythrocytes were 3,500,000, leucocytes 11,700 with 88% neutrophiles, and the heterophile agglutination was positive up to 1 : 112 dilution. Chest x-ray was negative. However, bacteriological studies failed to confirm the diagnosis of diphtheria. The patient was discharged from the County Hospital with a fever ranging between 101 and 102 F, in spite of intravenous fluids and antibiotics in large doses.

On Oct. 9, the patient was seen once again in her home and she felt a great deal better. It was at this time possible to visualize the larynx more readily and the arytenoids were seen to be fiery red.

However, on Oct. 11, the patient was much worse, with a temperature of 104 F, and a tremendous diffuse swelling of both sides of the neck. She was readmitted to the hospital and x-rays of the neck ordered. These demonstrated a loss of the normal lordotic curve in the region of the cervical spine with a slight reversal of this curve. There was a large soft-tissue space between the anterior portion of the bodies of the cervical spine and the posterior aspect of the trachea. The trachea appeared to be displaced forward, as did the pharynx, suggestive of a soft-tissue mass in the postpharyngeal and the post-tracheal regions. See Figure 1.

On Oct. 12, the patient was taken to surgery and the neck was explored through a right cervical incision along the anterior border of the sternocleidomastoid muscle. After the subcutaneous tissue

Submitted for publication March 28, 1955.

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Fig. 1.—Lateral view of the neck (Oct. 11, 1952) demonstrating a loss of the normal lordotic curve in the region of the cervical spine with a large soft-tissue space in the postpharyngeal and posttracheal region, suggesting a retropharyngeal abscess.

and the platysma were separated, the carotid sheath was identified and retracted. While this was being done, a huge abscess cavity was entered. The pus was evacuated, and a large Penrose drain was inserted. Approximately 400 cc. of pus was obtained from the cervical abscess. There was no evidence of a foreign body, but there was a fistula into the right piriform sinus.

It was at this time that it was learned that at the age of one year, on Dec. 25, 1934, the patient swallowed a Christmas-tree ornament. She was taken to Dr. Simon Jesberg, who on Dec. 26 did a pharyngoscopy and laryngoscopy and removed remnants of the glass from the pharynx. The pharynx was badly lacerated along the posterior pharyngeal wall. Thereafter, he performed an esophagoscopy and found the esophagus to be free of foreign body or trauma. The patient was sent home the next day, on Dec. 27, 1934. However, she was readmitted the next day because of a temperature of 104 F. A laryngoscopy and esophagoscopy was one again performed. No foreign body was found, but thick pus was seen to come from the laceration on the posterior pharyngeal wall. A chest x-ray was taken on that day and found to be negative. The patient's course in the hospital at that time was extremely stormy. On Dec. 29, 1934, an x-ray was taken of the esophagus using barium, and an abscess on the right at the level of the second rib and another at the level of the eighth rib on the left were identified. These were considered to be periesophageal abscesses and were opened into at the time of esophagoscopy on Dec. 31, 1934. A tremendous flow of pus was seen to come from these abscesses into the esophagus.

The patient was fed through a nasal feeding tube. Her condition was considered very serious, and the chance of recovery from this suppurative mediastinitis and the periesophageal abscesses was considered poor. On Jan. 2, 1935, the temperature was again 104 F and pus was pouring out of the mouth and the nose. Nevertheless, the patient continued to get well, the temperature subsided to normal, and she once again was able to take nutrition. She was discharged on Jan. 21, 1935, with the diagnosis of a foreign body of the pharynx with retropharyngeal and periesophageal abscesses.

With this history in mind, a review of the x-rays was made, but there was no evidence of a foreign body. Her postoperative course after the incision of the retropharyngeal abscess was quite favorable. The temperature fell to normal within 24 hours, although the wound continued to pour pus. There was an obvious pharyngeal fistula, with some of the liquid food coming through the skin incision. Culture of this pus revealed anaerobic streptococci and staphylococci. On Oct. 17th, the drain was removed. The patient felt considerably improved, although there was some pain in the back of the

Fig. 2.—Lateral view of the neck (Jan. 5, 1953) demonstrating the marked thickening of the prevertebral space due to soft-tissue swelling and air, which displaces the larynx and trachea anteriorly.

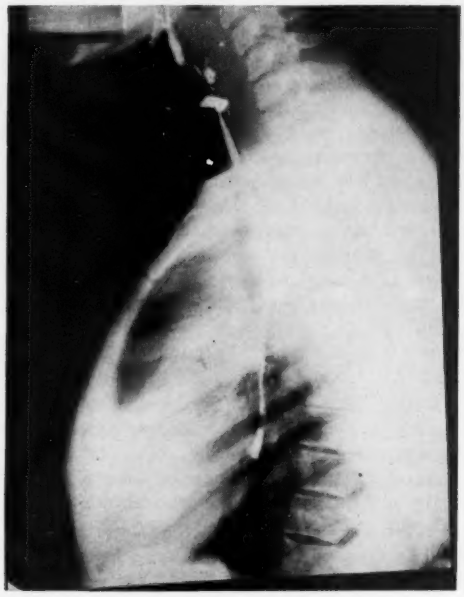


Fig. 3.—Lateral view of the neck and chest (Jan. 5, 1953) demonstrating a sinus tract in the right cervical region at the level of the sixth vertebra with an extension into the lower region of the neck just posterior to the trachea on the right and then down into the posterior mediastinum to the level of the sixth thoracic vertebra. This was considered a blind sinus tract lying posterior and somewhat to the right of the thoracic and cervical esophagus without apparent communication with the esophagus or trachea.

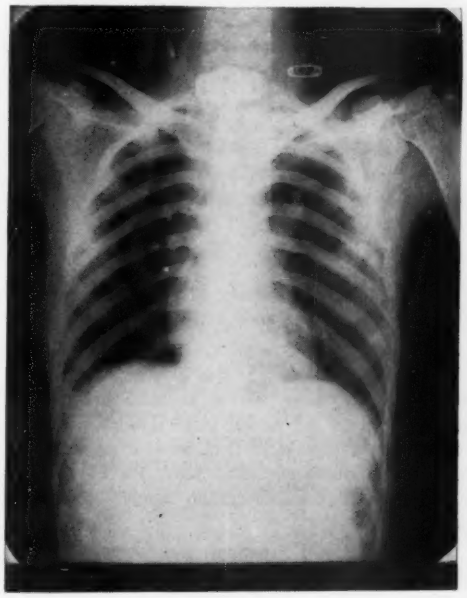
neck when she swallowed. On Oct. 27, 1952, she was discharged afebrile from the hospital, with the neck wound continuing to suppurate. Sulfisoxazole by mouth was prescribed, because the organisms were reportedly resistant to all antibiotics.

The patient was seen approximately three times a week thereafter. Culture reports showed primarily an anaerobic, nonhemolytic Streptococcus, with some variation as to sensitivity to the various antibiotics. There was never any evidence of tubercle bacilli, fungi, etc., in the bacteriological studies. Many antibiotics were tried (oxytetracycline [Terramycin], chloramphenicol [Chloromycetin], chlortetracycline, and penicillin orally), and penicillin was irrigated into the wound. By Dec. 30, 1952, the neck wound had almost completely stopped discharging and the patient was asymptomatic. Because of this improvement, it was advised that she reenroll on a part-time basis at the University.

However, on Jan. 5, 1953, the patient again developed dysphagia and fever and the neck wound suddenly opened up, pouring large amounts of purulent material. A lateral x-ray of the neck was taken and a marked thickening of the prevertebral space could be seen due to soft-tissue swelling and air. This displaced anteriorly the larynx and trachea. See Figure 2. After this, iodized oil (Lipiodol) was injected into the neck wound and x-rays taken. These revealed a sinus tract in the right cervical region at the level of the sixth cervical vertebra with an extension into the lower region of the neck just posterior to the trachea on the right and extending into the posterior mediastinum to the level of the sixth dorsal vertebra. This appeared to be a blind sinus tract lying posteriorly and somewhat to the right of the thoracic and cervical esophagus without apparent communication with the esophagus or the trachea. See Figure 3.

Because of these findings, the patient was readmitted to the hospital. Again complete blood and urine studies were made, most of which were normal. The sedimentation rate, however, was 37 mm. per hour. A thoracic surgeon, Dr. Francis X. Byron,[1] was asked to see the patient in consultation. He advised an incision and exploration of the posterior mediastinum through the neck. This was performed on the following day, Jan. 7, 1953, and through-and-through drainage was obtained from behind the pharynx and esophagus, making an incision on both the left and right sides of the neck. A catheter was introduced into the mediastinal abscess. Because of the difficulty in intubating the patient a tracheotomy was neces-

Fig. 4.—Chest x-ray taken Jan. 8, 1953, demonstrating the tracheotomy tube in place; safety pins on both ends of the drain going in on one side of the neck, through the postpharyngeal space, and out the other side; no abnormality of the lungs or mediastinum.



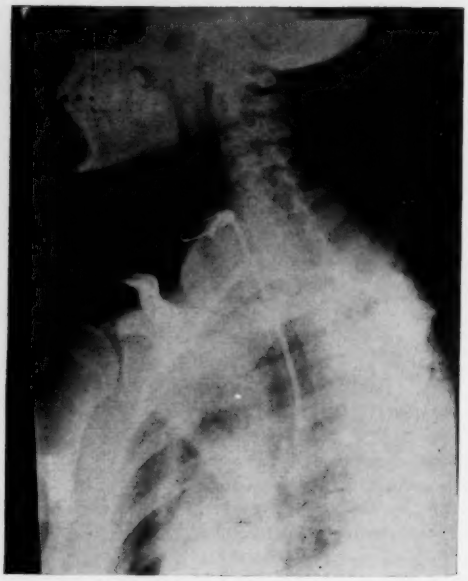


Fig. 5.—Lateral view of the neck and chest (Jan. 9, 1953) showing the catheter entering the neck wound and extending down into the mediastinal sinus tract.

sary at the time of surgery. There was approximately 50 cc. of organized pus in the retropharyngeal cavity. The tissue removed at the time of surgery was reported by the pathologist as showing (1) acute and chronic inflammation and (2) granulation tissue with foreign-body giant-cell reaction.

A portable chest x-ray was taken on the first day postoperatively, which showed the tracheotomy tube in place; the pins on both ends of the drain going in one side of the neck, through the postpharyngeal space, and out the other side; no abnormality of the lungs or mediastinum. See Figure 4. On the second postoperative day the tracheotomy tube was removed and a lateral x-ray of the chest was taken showing the catheter entering the neck wound and extending down into the sinus. See Figure 5.

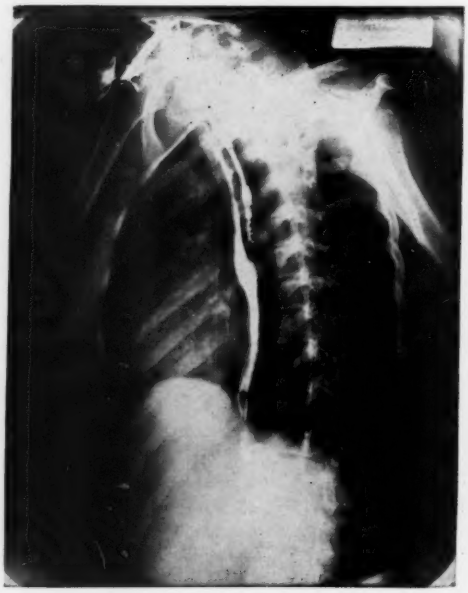
The patient was started on streptokinase-streptodornase (Varidase) irrigations through the catheter, followed by the instillation of bacitracin. The latter was suggested by Dr. William Hewitt, after studying the cultures from the most recent surgery. However, each time that this was done there followed a high fever, severe malaise, and profuse discharge from the wound. All of which disturbed the patient tremendously and made it necessary to discontinue this form of therapy. As a result of these daily chills and fever, she became discouraged and depressed.

On Jan. 15, the patient was completely disoriented and was seen by the psychiatrist, Dr. Charles Sturdevant, who had the impression that this was a toxic psychosis. All drug therapy was therefore discontinued. On Jan. 17, the patient was still psychotic, and a lumbar puncture was performed, which was found to be entirely normal. Her condition very slowly improved physically, but her emotional reaction was still one of deep depression. She was disoriented and had delusions. A complete study of the blood chemistry was made and revealed normal potassium, chlorides, total protein, albumin, globulin, calcium, phosphorus, sodium. The spinal Kolmer test was negative, and the colloidal gold curve was normal. The hemoglobin was 11.5 gm/100 cc. and the erythrocyte count was 3,620,000. A 500 cc. whole blood transfusion was administered.

On Jan. 22, an attempt was made to pass a stomach tube because the food was passing out the pharyngeal fistula to the skin. The patient became irrational and unmanageable. She was controlled thereafter only by paraldehyde.

Dr. George Hummer, of the Department of Pathology, was called in consultation at this time, and it was his opinion that this was a suppurative mediastinitis secondary to a suppurative cervical and probably mediastinal adenitis. He also stated,

Fig. 6.—Oblique view of the chest (Jan. 28, 1953) after the radiopaque medium had been injected into the catheter in the mediastinal tract. Under fluoroscopy it could be seen that some of the oil entered the esophagus from the distal end of the tract and passed on into the stomach. This cannot be seen in this film. Thereafter, the oil welled up into the pharynx through the neck abscess and the piriform sinus and was swallowed. This resulted in the picture seen above.



"Tuberculosis and the other granulomata appear to be ruled out from animal studies and the bacteriology; foreign body cannot be proved or disproved."

On Jan. 28, 1953, iodized oil was injected into the catheter, which entered the cervical sinus and extended down the tract in the mediastinum. This was done under fluoroscopy, and for the first time a fistulous connection was identified at the distal end of the tract between the tract and the esophagus at about D-5. Thereafter, the radiopaque medium welled up the tract into the piriform sinus and was swallowed into the stomach (Fig. 6).

A medical consultation was held with Dr. John Davis, who suggested pharyngoscopy and esophagoscopy in an effort to identify a foreign body. This was done on the day following the x-rays, and no foreign body or tumor was seen. The fistula in the right piriform sinus contained food particles. A biopsy specimen was taken from the area, revealing only chronic inflammation. The fistula at the end of the mediastinal tract could not be identified, but there appeared to be a fistulous opening behind the right tonsil in the lateral pharyngeal wall. The tonsils themselves appeared innocuous. A polyethylene stomach tube was passed by using the laryngoscope.

After this, the patient appeared to improve. Although she was more rational, Dr. Sturdevant concluded that this was definitely a schizophrenic reaction, with the toxic factor a mere precipitating cause. An electroencephalogram showed " an abnormally low voltage record with no focus." Her weight was 98 lb., at least 25 lb. below her usual weight. She was afebrile.

On Feb. 7, the patient was given methylene blue to swallow, and it appeared quickly in the neck wound. She was more cooperative, and it was possible to remove the plastic feeding tube and insert a Penrose tube into the stomach. Large doses of erythromycin were given through the tube, but the neck wound continued to suppurate profusely. The electrocardiogram showed a mild tachycardia and some inversion of the T waves.

In the middle of the night on Feb. 17 the patient choked and "half coughed up the stomach tube." The intern was called, and he removed it completely. Dr. Byron believed that the catheter in the mediastinal tract might be preventing its healing. The drain was shortened each day, and finally on March 9, 1953, the catheter was removed. She was discharged from the hospital on March 15, 1953, with the following discharge note: "The patient's condition is essentially the same as it was on admission January 6th. She still has a suppurating sinus in the right neck, a pharyngeal fistula, and a mediastinal sinus tract with an esophageal fistula at the distal end. Her mental condition is now improved—she is lucid, her mood is bright and sleep is regular. Her nutrition is much improved."

On April 7, Dr. Francis Byron talked to Dr. Richard Sweet, of Boston, regarding this particular case, and showed him her x-rays. He suggested that this could be a congenital duplication of the esophagus. The patient took a two-week vacation at Palm Springs, Calif., and returned on April 16 looking good generally, with the neck wound completely healed. On April 23 she suddenly had a high spiking fever and developed a retropharyngeal swelling once again and a tonsillitis. It was at this time that it was suspected that the tonsils were the focus of infection and were maintaining this cervical suppuration. On April 25, she was seen to have a diffuse fluctuant swelling on the left side of the neck as well as the right. Pus was obtained when a probe was passed through the right neck wound across to the left side. Culture of this pus was reported to show a hemolytic Staphylococcus, coagulase-positive. After the wound was opened, the patient improved dramatically, although pus and food came through the neck incision in great quantities. The parents took the girl to a dentist, who x-rayed her teeth and found no infection but two impacted lower third molars. They also consulted another otolaryngologist, who strongly advised a tonsillectomy immediately. On May 16, with use of the Barton endotracheal tongue blade,[2] a tonsillectomy was performed at St. John's Hospital, in Santa Monica, Calif. The tonsils were relatively small, but they were filled with debris. The retropharyngeal space was incised and only a diffuse, firm swelling was identified with no pus obtained. The bleeding from the tonsil area was minimal and controlled by one suture. At the time of surgery no retrotonsillar or peritonsillar abscess or fistula was seen. Postoperative condition was good, and she was discharged from the hospital on May 19.

During the months of June and July, 1953, the patient got along well with minimal discharge from the right neck wound, but an area of granulations in the incision in the posterior wall began to spring up. From this area there was a steady flow of pus into her throat. It should be noted that guinea-pig studies and all the bacterial studies had ruled out the various specific granulomata, such as syphilis, tuberculosis, blastomycosis, etc. The pathologist reported the tonsils, removed May 16, to show a moderate amount of chronic inflammation with hemorrhagic follicles and that the tonsils had been cultured. This culture report was later made of a Pseudomonas aeruginosa. She began to anticipate reentering the University of California at Los Angeles in September and the routine smallpox vaccination given. This resulted in a marked febrile reaction, a primary vaccinia, which subsided in one week.

On Aug. 17, 1953, the neck suddenly swelled up and pus began to drain from the wound. Iodized oil was instilled and x-rays were again taken

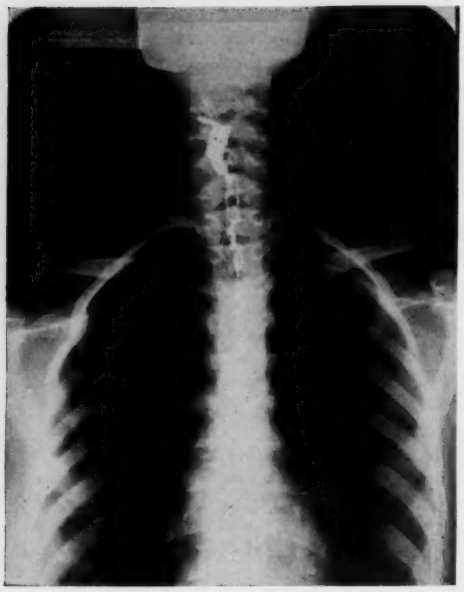


Fig. 7.—X-ray taken Aug. 17, 1953, after iodized oil had been instilled in the sinus opening into the neck. This demonstrated no appreciable change in the length or width of the sinus tract.

Fig. 8.—Photograph of specimen with paper arrow in skin to mediastinum sinus tract, which continues downward and behind the esophagus to a point at approximately the junction of the lower and middle thirds of the esophagus.

(Fig. 7). These showed no appreciable change in the length or width of the sinus tract, certainly no sign of healing. This time no antibiotic was given and the patient was allowed up and around, wearing a small dressing over the neck wound. She recovered just as rapidly as before, and soon began her college-sorority social life.

However, on Aug. 22, 1953, the patient experienced a sudden chill, which was followed by fever, "swollen throat," and a "flu-like" feeling. She was started on a combination of penicillin and methdia-mer-sulfonamides orally. Although she did not

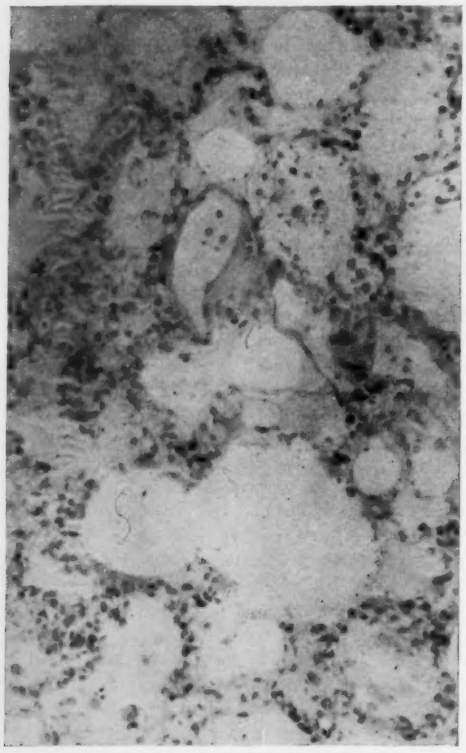


Fig. 9.—Microscopic section of lung demonstrating pulmonary edema and pneumonitis.

feel well enough to get out of bed, she did feel much better on the succeeding two days. However, on Aug. 25th, the dysphagia was more intense, the temperature was 103 F, and she complained of intense headache. Examination revealed a moderate rigidity of the neck, a rotary nystagmus on lateral gaze bilaterally, some numbness and weakness of the extremities, and considerable degree of mental confusion. She was rushed to the hospital with the provisional diagnosis of metastatic brain abscess, but she died within two hours after admission before further studies had been made.

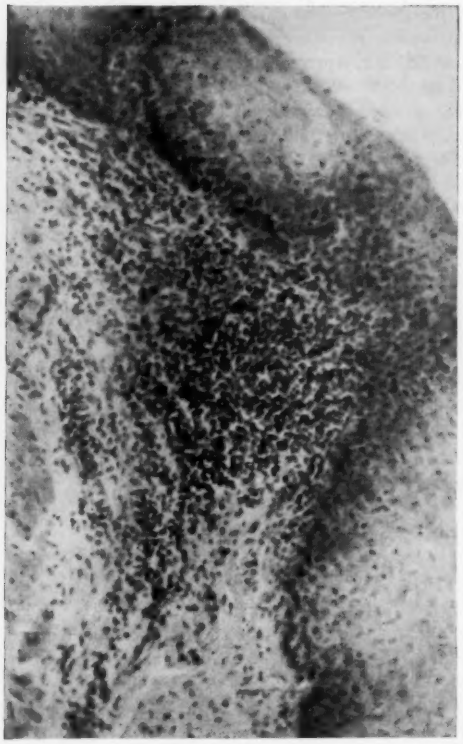
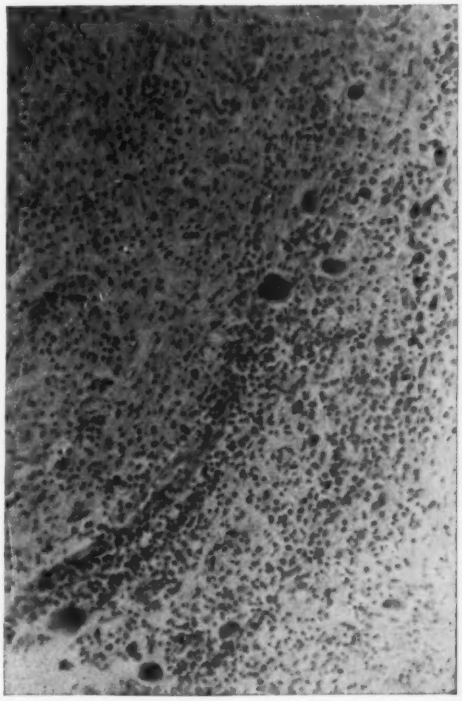


Fig. 10.—Section of esophageal wall showing chronic esophagitis.

Autopsy Report.—The positive findings of the postmortem examination performed by Dr. G. J. Hummer were such that he was unable to explain the immediate cause of death with accuracy. In the midanterior right half of the neck was a scarred area 1 cm. in diameter, the site of a fistulous tract, which when gently probed extended into the pharynx and likewise downward into the mediastinum and proceeded deep in the midportion of the mediastinum to below the level of the aortic arch. The sinus tract of cervical portion of skin to mediastinum was carefully dissected out. The sinus tract paralleled the course of the internal jugular vein, exposing this structure as if it had been finely dissected. There was no evidence of hemorrhage, however, about the vein, and no defect in the vein wall was detected. The sinus tract entered the skin immediately anterior to the anterior border of the sternocleidomastoid muscle and extended into the pharynx on the right side at a level immediately superior to the piriform sinus. This defect in the pharyngeal wall was surrounded by an erythematous halo and totaled approximately 5 mm., in diameter. The sinus tract further proceeded immediately behind the esophagus, crossed the posterior border of the esophagus transversely and downward, and extended along the left border of the retroesophageal tissue to a point at approximately the junction of lower and middle thirds of the esophagus. At this point the sinus tract entered the lumen of the esophagus, the defect in the esophageal wall being the site of granulation tissue, hyperemic and totaling approximately 5 mm., in diameter. No foreign body was encountered in this well-demarcated sinus tract and fistulous tract, which was lined by glistening, gray-tan granulation tissue and whose walls were moderately thickened and semicartilaginous in appearance and averaged approximately 3 to 4 mm. thick. Only a small amount of liquid pus was noted in this sinus tract. No foreign bodies of any type were encountered (Fig. 8).

There was a mild bilateral hydrothorax, with each pleural space containing approximately 150 cc. of clear-colored fluid. The lungs were extremely edematous and moderately hyperemic, while the entire tracheobronchial tree was filled with a mixture of semifrothy fluid and frankly purulent exudation. The pulmonary parenchyma was found to exude uniformly throughout an abundant frothy fluid admixed with pus. All other organs were grossly free of abnormality, including the brain.

Fig. 11.—Section through wall of fistulous tract demonstrating chronic inflammation and foreign-body giant cells. No actual foreign body was ever encountered, however.



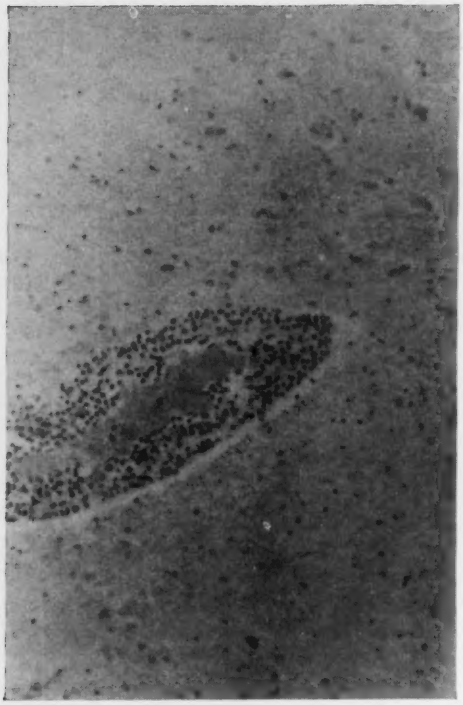


Fig. 12.—Section through the medulla oblongata showing the perivascular round-cell infiltration, the characteristic "cuffing" of the vessels.

There was no evidence of meningitis or of abscess formation noted in careful examination of the central nervous system.

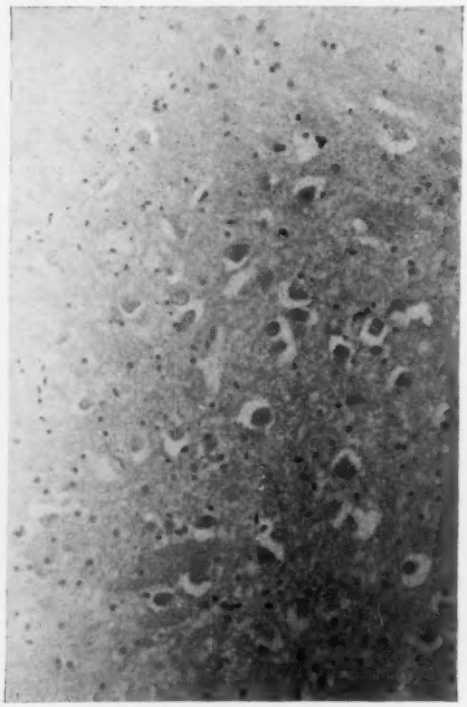
Dr. Hummer commented after the gross postmortem examination as follows, "The pulmonary edema in this case is extreme and from the anatomic dissection it is impossible to see how oxygen exchange took place in this lung. It is presumed that the free pus noted clinically to be pouring from the cervical skin and mediastinal fistula may have been aspirated into the respiratory tree. Air embolism in this case cannot be included or excluded, although it remains a possibility according to the clinical history of rather sudden demise. However, onset of pulmonary edema was present at least an hour and fifteen minutes prior to death. The extreme pulmonary edema, although of obscure cause, is sufficient to explain the impossibility of respiration and, therefore, death."

The microscopic findings confirmed the gross diagnoses of extreme pulmonary edema (Fig. 9), pneumonitis, chronic bronchitis, peribronchial lymphadenitis, chronic esophagitis (Fig. 10), and a nonspecific chronic inflammatory tract of the mediastinum (Fig. 11). However, the microscopic sections of the brain were reported by Dr. J. S. Berryman in detail as follows, "H and E section of the medulla oblongata at the level of the motor decussation reveals generalized round cell infiltration in the leptomeninges and about all blood vessels within the spinal cord. [See Fig. 12.] These cells are lymphocytes and polymorphonuclears. In the region of the anterior horn cells, no neurons can be identified. There are a few degenerative forms, but no normal neurons. The gray matter has taken on a status spongiosus effect. High power examination of this region reveals great numbers of microglial cells in clusters with beginning proliferation of astrocytes. [See Fig. 13.]

"H and E section of the medulla oblongata at a higher level in the region of the sensory decussation reveals intense inflammatory reaction around all blood vessels with accumulations of great numbers of lymphocytes. Glial nodules composed of microglial cells are everywhere in evidence. The motor neurons of the twelfth cranial nerve reveal generalized tigrolysis. There is no recognizable chromatin.

"Neurons of the dorsal efferent nucleus of the vagus nerve show little inflammatory or degenerative changes. Neurons in the region of the anterior horn complexes are better preserved at this level, and many are normal. There is intense inflammatory change in the region of the nucleus ambiguus and

Fig. 13.—Section demonstrating the destruction of the motor neurons and the spongiosus effect of the gray matter.



only one or two neurons can be discerned. All forms of microcytosis are in evidence.

"H and E section through the pons in the basilar portion reveals scattered lymphocytes in the leptomeninges. The nuclei of the nucleus pontis are normal. There is no evidence of involvement of the basilar portion of the pons. Sections through a portion of medulla at the level of the inferior olivary nucleus reveal marked perivascular encephalitis with great collection of lymphocytes. The neurons of the olivary nucleus are normal. There is no particular involvement of the reticular formation."

Dr. Hummer's final comments were, "This is an extremely unusual case of acute bulbar poliomyelitis with extremely rapid course which complicated as an added and new clinical feature the existing clinical feature of esophageal-mediastinal to cervical skin fistula. Careful examination of this fistulous tract revealed no evidence of foreign body. Particular search was made for presence of Christmas tree ornament material which, according to the history, patient swallowed as child. The microscopic changes of brain, brain stem and its coverings are striking."

The final anatomic diagnosis was therefore listed as (1) acute anterior encephalopoliomyelitis with involvement of the medulla oblongata; (2) pulmonary edema, Grade IV; (3) subacute and chronic suppurative mediastinitis with chronic cervical skin to pharynx, to mediastinum, to esophagus fistula; (4) mild bilateral hydrothorax.

COMMENT

That this was a unique case was apparent from the review of the literature. No similar instance of recurrent periesophagitis and mediastinitis was found after exhaustive search. One report by Byron [1] described a chronic fistula and mediastinitis two years after a traumatic perforation at the time of esophagoscopy.

It was my impression that the periesophageal abscesses, although healed from the childhood episode, had left a potential space which filled up years later at the time of the severe pharyngeal infection. The distal opening of the tract into the esophagus was only large enough to admit a tiny silver probe. At autopsy this was blocked by food particles. This is undoubtedly why the iodized oil did not always pass on into the esophagus and at times gave the appearance of a blind tract. Also, it probably explains the episodes of "healing" of the sinus and then the sudden rupture of pus from the wound. Probably as long as the distal end of the tract remained patent, the food and debris passed on into the esophagus without complication. However, when the opening became clogged with food particles and pus, the infection dammed up and finally broke open the neck wound anew.

In retrospect, it is obvious that antibiotic therapy could never have cured the mediastinitis as long as there was the constant contamination of the tract with food and saliva. Furthermore, any attempts at surgical excision of the tract would have been disastrous because of the extreme cicatrization. Drainage of the tract through a thoracotomy incision was considered inadvisable, as it would produce no better drainage than the collar mediastinotomy [3] and would, at the same time, contaminate the pleural cavity, adding empyema to the rest of the complications.

At the time of the patient's last illness, gastrostomy was being considered as a device for keeping the area clean in conjunction with a feeding tube. However, autopsy demonstrated how little chance this would have had of helping.

The nature of the first infection, in October, 1952, was never clearly established. The local health officers were never convinced that the slides and cultures contained truly pathogenic organisms. The blood smears never revealed the atypical cells of infectious mononucleosis.

The x-ray shown in Figure 2 demonstrated a typical picture of the symptom of Minnigerode.[4] The air in the retropharyngeal space with a fluid level was first described by him as pathognomonic of a perforation of the esophagus. It was this sign which led me to instill the radiopaque material.

The question has often occurred to me, "Did the recent tonsillectomy (three months before) and/or the chronic pharyngeal suppuration render the patient more susceptible to poliomyelitis and especially the bulbar form?" The indications are that it undoubtedly did and that the tonsils never played an important role in the mediastinitis

in this case. Schmidt [5] recently attributed mediastinal infection more to tonsillar affections than to esophageal injuries.

The severe pulmonary edema baffled us at the time of the patient's death. It was our speculation that the mediastinal abscess had ruptured into a bronchus and had resulted in an aspiration of the entire contents of the tract. This was still puzzling at the time of autopsy, because no explanation could be made for the extreme edema of the lungs and the complete filling of the tracheobronchial tree with secretions. It was not until the diagnosis of bulbar poliomyelitis was made weeks later that the picture made sense.

Serial sections were made of the entire cervical-mediastinal tract and no foreign body was found. However, there were many foreign-body giant cells. These could have simply been from the food particles in the tract or could have resulted from the glass of the Christmas ornament. But none of the latter was ever found, in spite of an exhaustive gross and microscopic hunt.

SUMMARY

This case represents an unusual complication of a foreign body of the esophagus, i. e., a long-delayed retroesophageal inflammatory tract which could not be cured by medical or surgical means. The final outcome of the mediastinal suppuration remains unknown, because of the fatal intervening infection—bulbar poliomyelitis.

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BRONCHIAL GRANULAR-CELL MYOBLASTOMA

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THE TUMOR generally referred to as granular-cell myoblastoma, while usually found in locations where striated muscle is normally present, is not uncommonly found in areas where this type of muscle is not ordinarily found.

The commonest locations of this type of tumor are in the skin and tongue. Other frequent sites are extremities, head, trunk, larynx, and gums. Less frequent locations are uterus, vulva, bladder, orbit, appendix, perianal region, stomach, esophagus, omentum, and retroperitoneum. In 1945 Crane and Tremblay [1] reported on the various locations of 162 cases of granular-cell myoblastoma. Murphy, Dockerty, and Broders [2] in 1949 reviewed all the cases which had been reported up to 1947. To these, they added 10 of their own. More recently, Stout [3] reviewed the location and histology of 136 examples of myoblastoma.

Its widespread distribution in tissues unrelated to the skeletal system excites the wonder of those who would explain the histogenesis of myoblastoma. The original concept of Abrikossoff [4] that these tumors develop from embryonic muscle cells is reflected by the name in common usage. This idea has been reinforced by the work of Murray,[5] who found that tissue cultures of these tumors most nearly resemble striated muscle. Various investigators have postulated that myoblastomas develop from histiocytes,[6] Schwann cells,[7] and granular-cell fibroblasts.[8] Gullino [9] suggested that these lesions are granulomas induced by parasites. A theory that these are not tumors, but a form of granular myolysis, was reported by Roffo.[10] The greatest deterring factor in the acceptance of the muscle-cell origin is that, while many of the tumors have been found in striated muscle, there are probably an equal number which are found elsewhere.

Although these tumors often are considered benign, in Stout's series of 136, sixteen were malignant.[3] Four cases which were originally considered benign were found later to have metastases. Three more cases of malignant granular-cell myoblastoma were reported by Ross and associates.[11]

Few cases of tracheal and bronchial myoblastoma have been published. Kramer,[12] in 1939, related the case of a 15-year-old girl who had an occlusive myoblastoma of the right lower lobe bronchus. Liebow [13] described a case of a 59-year-old man who had a myoblastoma in the left upper lobe bronchus. The former case was mentioned in the reviews of Crane and Tremblay and Murphy, Dockerty, and Broders.

The case reported here is an example of myoblastoma of the bronchus which clinically in many ways resembles bronchial adenoma.

REPORT OF A CASE

E. A., aged 18 years, was admitted to the University Hospital with the complaint of fever, dyspnea, and pain in the right chest. These symptoms followed an upper respiratory infection which had begun three weeks prior to admission. The patient had undergone tonsillectomy at age 14. There had been three attacks of pneumonia in the past three years. On admission the temperature was 104 F; the pulse rate, 130; respirations, 36; the blood pressure, 110/70. There was mild dullness of the right base, and fine moist râles were heard over the lower two-thirds of the right chest. The white blood cell count was 21,900; hemoglobin was 10.4 gm. Cold agglutination tests were positive at 1:64; negative at 1:128. Sedimentation rate was 38 mm. per hour;

Submitted for publication Feb. 7, 1955.

Aided by a grant from the Sydney M. Cone Research Fund.

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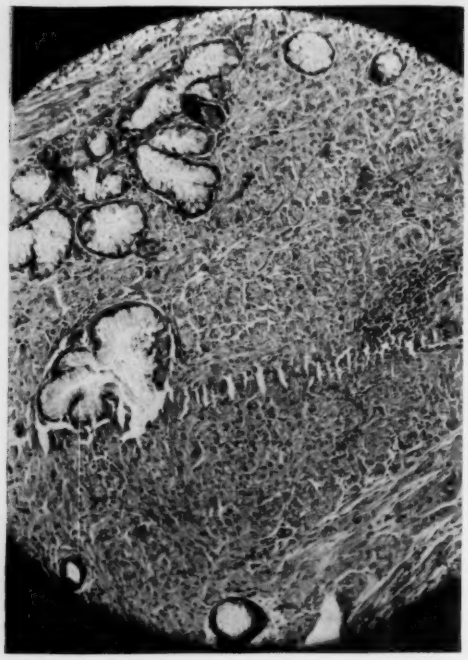
Fig. 1.—Narrowing of left main bronchus.

Fig. 2.—Bronchial granular-cell myoblastoma; hematoxylin and eosin stain; reduced 3/7 from mag. × 100.



hematocrit, 40%; eosinophiles, 164 per cubic millimeter. The sputum showed a heavy growth of Pneumococcus, Neisseria catarrhalis, and alpha Streptococcus.

Roentgenograms of the chest showed consolidation of the right middle lobe and the upper portion of the right lower lobe. The only significant finding in the left side of the chest was prominence of the left hilus, which was felt to be due to vascular changes rather than lymph-node enlargement. After maximum clearing, iodized oil (Lipiodol) installation revealed a marked cylindric and saccular bronchiectasis of all lobes of the right lung. On the left

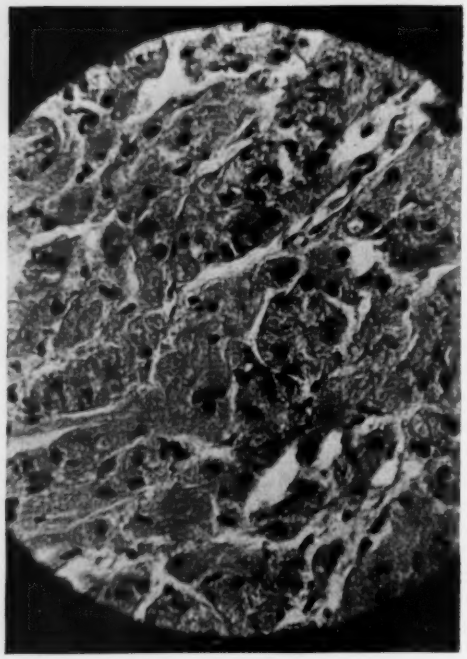


Fig. 3.—Bronchial granular-cell myoblastoma; hematoxylin and eosin stain; reduced 3/7 from mag. × 440.

side there was moderate narrowing of the left main stem bronchus at the origin of the left upper lobe bronchus.

Endoscopic examination of the bronchial tree showed a small amount of purulent exudate at the right middle lobe orifice. The mucosa of the superior segment of the right lower lobe bronchus was congested and edematous. In the left main stem bronchus there was seen an area approximately 2 cm. in diameter, which produced slight to moderate occlusion. The mass had a finely lobulated surface and arose from the anterior medial wall. The area bled

rather easily when manipulated. Several fragments of the tumor were removed for histologic study.

Because of the extreme bronchiectasis of the right lung, the decision was made to remove the tumor bronchoscopically. Three additional examinations produced multiple small fragments of the tumor. Rather profuse bleeding prevented total removal. The last bronchoscopic examination was made four weeks after the initial diagnostic examination. At this time the tumor was found to be considerably smaller, with no appreciable obstruction of the bronchus.

Gross examination of the tumor on each occasion revealed four to six fragments of somewhat firm gray-white tissue. The fragments ranged from 0.3 to 0.8 cm. in diameter.

The histologic appearance was typical of granular-cell myoblastoma when found in the commoner sites. It consisted of masses of large well-defined polyhedral cells. The cytoplasm was voluminous, acidophilic, and granular. The nuclei were small and deeply stained. The connective-tissue stroma was quite sparse. Small groups of mucous and serous glands were scattered throughout the tumor. A few small accumulations of lymphocytes were present. Tissue resembling striated muscle was not seen. In none of the sections examined was any area found having an epithelial covering.

SUMMARY

A case of granular-cell myoblastoma occurring in the bronchus is reported. Comment is made on the theories of histogenesis, the various sites of origin, and views on malignancy.

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EPISTAXIS

Control by Ligation of Anterior Ethmoidal Artery

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THE ATTENTION of the otolaryngologist has become more focused on the need in a severe case of intractable nasal hemorrhage of pinpointing the exact location of the hemorrhage, in order to obviate, if possible, the necessity of ligating arteries unnecessarily. To ligate an external carotid artery without avail, only to find that ligation of the anterior ethmoid artery caused the complete cessation of all bleeding, raises the question whether more careful elimination of the sources of bleeding would not have eliminated ligation of the external carotid in the first place. It goes without saying that all other methods of stanching nasal hemorrhage have been utilized. It is not my purpose to go into the numerous armamentaria of drops, packs, balloons, coagulants, styptics, sclerosing solutions, irradiation, transfusion, fulguration, and what not. This has been clearly and minutely detailed very well by Ogura and Senturia.[1]

When these fail, ligation of arteries becomes essential. Nasal hemorrhage can be extremely shocking, both to the patient and to the doctor. Macbeth[2] reports a case where, after ligation of the external carotid, the patient died. Failure to ligate the anterior ethmoidal artery may have been a contributing factor. Barton's description[3] of the picture of a nasal hemorrhage as seen when he was called to the home is as familiar as it is vivid. The patient lying in a bloody pool, with relatives anxiously trying to help, is a trying situation for all concerned. Much can be done at the time in the way of sedation, calming the fears of the family and of the patient himself, but much of the necessary equipment can not be carried about and it becomes necessary to hospitalize the patient.

The determination of the location of the bleeding source in the presence of massive nasal hemorrhage may be difficult and time-consuming. But it is absolutely essential that this be done to avoid unnecessary surgery. Weddell and associates[4] said:

> In the absence of any clear teaching on the subject of surgical control of epistaxis it has become traditional to ligate first the external, then the common carotid arteries in desperate cases.
>
> It is surprising this state of affairs exists, for ligation or coagulation of ethmoidal arteries is a well-recognized step in the course of operative procedures in the neighborhood of the ethmoidal air cells. . . .

In most of the reports I have examined it is almost by rote that the writers, after finally succeeding in stopping the hemorrhage, make the statement that if it is possible to pinpoint the hemorrhage as coming from the area known to be supplied by the anterior ethmoidal artery it would be well to ligate that artery first. This may be all that is required. As late as July, 1954, Peluse and Fishler,[5] after ligating both external carotid and anterior ethmoidal arteries, said that from the knowledge gained from this and previous writers * it may be well to interrupt the anterior ethmoidal arteries first.

Sackadorf[6] reported in 1950 a similar problem requiring ligation of external carotids first, then the anterior ethmoidal arteries, and discussed the method of distinguishing between ethmoidal and carotid bleeding.

It might be well here to review the anatomical distribution of the vessels of the nose

Submitted for publication Dec. 15, 1954.

Chief, Ophthalmology-Otolaryngology Section, the Veterans Administration Hospital.

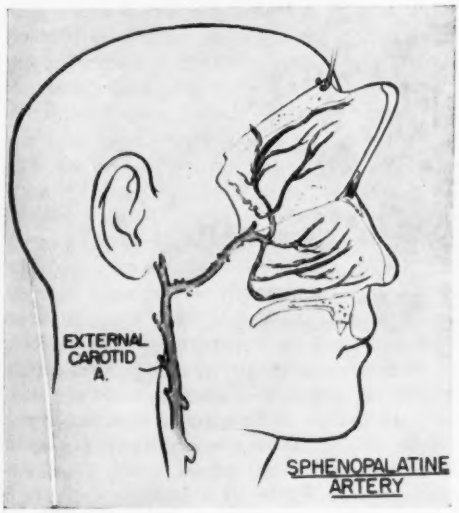
Read before the Greater Miami Eye, Ear, Nose and Throat Society, Miami, Fla., Oct. 21, 1954.

* References 7 to 10.

Fig. 1.—Blood supply to septum. Sphenopalatine artery running in mucosa of septum (3, 7); anterior ethmoidal artery (6). (Reproduced with permission from Barnhill, J. F., and Mellinger, W. J.: Surgical Anatomy of Head and Neck, Williams & Wilkins Company, 1940, p. 479, Fig. 268.)

and orbit involved in nasal hemorrhage and the site involved in the ligation of the anterior and posterior ethmoidal arteries.

Fig. 2.—Sphenopalatine artery, supplying nose. (Reproduced with permission from Barton, R. T.: Postgrad. Med. **15**:70-74 [Jan.] 1954, Interstate Postgraduate Medical Association.)



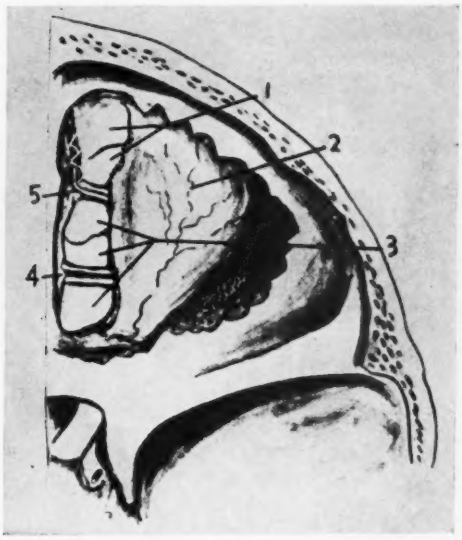


Fig. 3.—Upper right ethmoidal labyrinth and orbit exposed, showing intimate relation of cells to orbit. Anterior ethmoidal cells (1); periorbita (2), covering orbital contents completely; posterior ethmoidal cells (3); posterior ethmoidal artery and nerve (4); anterior ethmoidal artery and nerve (5). (Reproduced with permission from Barnhill, J. F., and Mellinger, W. J.: Surgical Anatomy of Head and Neck, Williams & Wilkins Company, 1940, p. 289, Fig. 167.)

Fig. 4.—Looking down into right anterior cranial fossa; roof of ethmoid and orbit cut away. Anterior ethmoidal cells (1); ophthalmic artery (6); posterior ethmoidal artery (9); posterior ethmoidal cells (10); anterior ethmoidal artery (12). (Reproduced with permission from Barnhill, J. F., and Mellinger, W. J.: Surgical Anatomy of Head and Neck, Williams & Wilkins Company, 1940, p. 356, Fig. 206.)

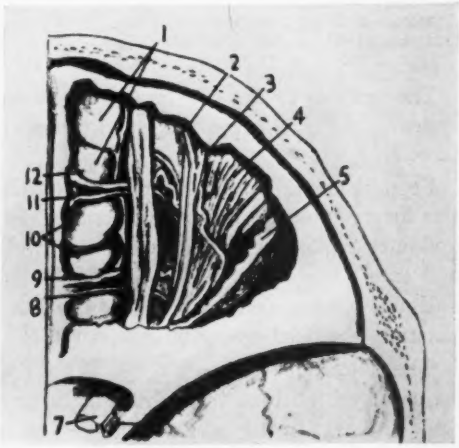


Fig. 5.—Arterial circulation of orbit and ethmoidal cells. Frontal sinus roof (1); right cribriform plate (2); anterior and posterior cells (3); anterior ethmoidal artery (4); posterior ethmoidal artery (5); nasociliary arteries (6, 10); frontal artery (7); ophthalmic artery (14); internal carotid artery (15). (Reproduced with permission from Barnhill, J. F., and Mellinger, W. J.: Surgical Anatomy of Head and Neck, Williams & Wilkins Company, 1940, p. 359, Fig. 208.)

The arteries of the nose come from two systems: the internal carotid and external carotid.

From the external carotid, the sphenopalatine artery branches to supply the posterior and inferior portions of the lateral nasal wall and enters the septum, supplying the lower half and anastomosing with branches of the anterior ethmoidal artery (Figs. 1 and 2).

The ethmoidal arteries come from the nasociliary branch of the ophthalmic artery and enter the nasal cavity from the orbit through the ethmoidal canals. They supply the ethmoidal cells, frontal sinus, and upper portion of the nose. After entering the nose through the nasal slit lateral to the crista galli, the vessels send branches to the septum and terminate on the dorsum after passing between the nasal bone and lateral cartilage (Figs. 3 to 7).

REPORT OF A CASE

I. G., aged 35, white man, was brought to the VA Hospital on July 15, 1954, with the history that bleeding began July 11 at 11 a. m. His nose was packed at his home by an E. N. T. specialist, who sent the patient to a hospital, where a posterior pack was applied. He was given a blood transfusion and was then transferred to the Veterans Hospital. Fifteen years ago he was treated in New York for a nasoangiofibroma with x-rays, radium needles, and fulguration, with no trouble since then to the present time.

The patient was very pale but very calm. I do not know whether it was because, as reported in another paper, he had resigned himself to the inevitable. He showed no evidence of fear or distress. When the pack was removed, he began to bleed heavily from the left side. At first, a glimpse of a definite pumper was obtained, but because of the massive nasal bleeding this could not be located. Packing was reinserted in the nose, and the patient promptly slumped to the floor. When he opened his eyes, he was unable to talk and his left leg was spastic and curled up under him. He soon recovered. Bleeding apparently was controlled with anterior packing; BP, 120/76; pulse, 116. He was admitted to the hospital. The next day during examination he had another syncopal attack during repacking. On the following day, as bleeding was still manifest, he was given a transfusion and a postnasal pack was reinserted. In a careful search of the nasal cavity the bleeding seemed to involve the floor and lateral wall of the nose, since the upper part of the nose was well packed off. The next day bleeding appeared to be stopped. The nasal packing was not too saturated. The pack was removed the following day and bleeding recurred. The bleeding was now located as coming from the septum high up anteriorly and pumping straight across the nasal cavity, as from a broken hose. This established the hemorrhage as coming from the anterior ethmoidal artery. (When bleeding can be observed definitely originating above the midturbinate, ligation of the anterior ethmoidal artery will be sufficient to stop hemorrhage.) The nasal cavity was immediately repacked with absorbable gelatin sponge (Gelfoam) gauze, and the patient

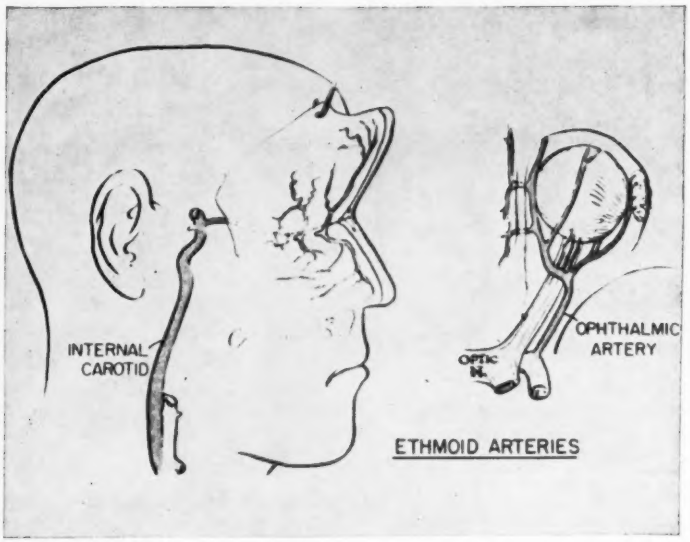


Fig. 6.—Ethmoidal arteries. (Reproduced with permission from Barton, R. T.: Postgrad. Med. **15**:70-74 [Jan.] 1954, Interstate Postgraduate Medical Association.)

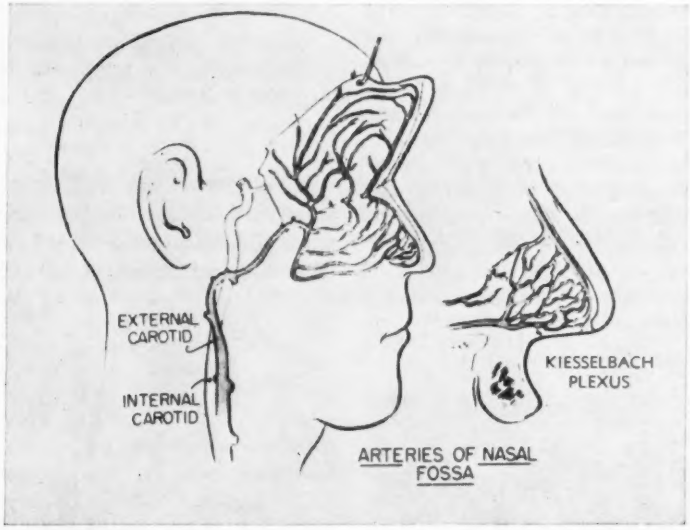


Fig. 7.—Arteries of nasal fossa: sphenopalatine and ethmoidal arteries. (Reproduced with permission from Barton, R. T.: Postgrad. Med. **15**:70-74 [Jan.] 1954, Interstate Postgraduate Medical Association.)

was prepared for surgery. A ligation of the anterior ethmoidal artery was carried out.

The technique of the operative procedure is simple. Local anesthesia with infiltration deeply along the medial wall of the orbit is sufficient. A curved incision was made medial to the inner canthus and down to the bone (Fig. 8). The periosteum was elevated downward and backward to a depth of about 1½ in. from the bridge of the nose, where the anterior ethmoidal artery and nerve were encountered crossing the cavity (Fig. 9). A Luongo suture carrier, or its equivalent, was slipped down and around the artery and the vessel doubly ligated (Fig. 10). The vessel was cut between sutures. Some men do not cut the artery; others place a clip on it. The fact that I cut it

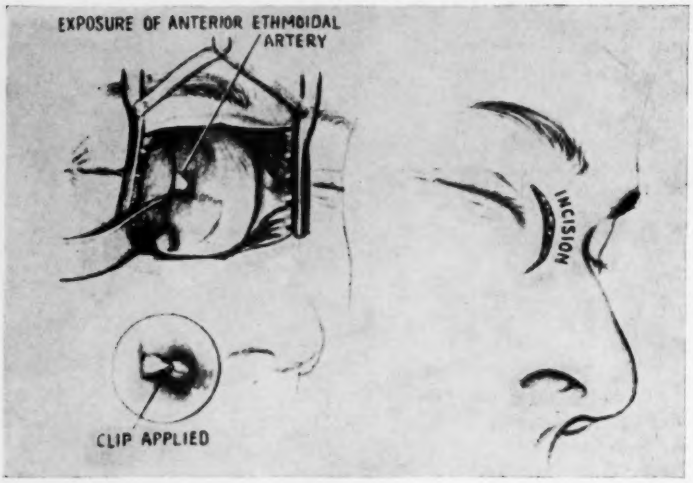


Fig. 8.—Incision, exposure of anterior ethmoidal artery. (Reproduced with permission from Weddell, G., and others: Brit. J. Surg. **33**:387-392 [April] 1946, Williams & Wilkins Company.)

led to a most unusual complication. The nasal and nasopharyngeal packs were removed, and an examination of the nose revealed complete cessation of bleeding in the nose. However, the eyeball began to proptose markedly, just as is occasionally seen after retrobulbar injection of procaine in cataract surgery.

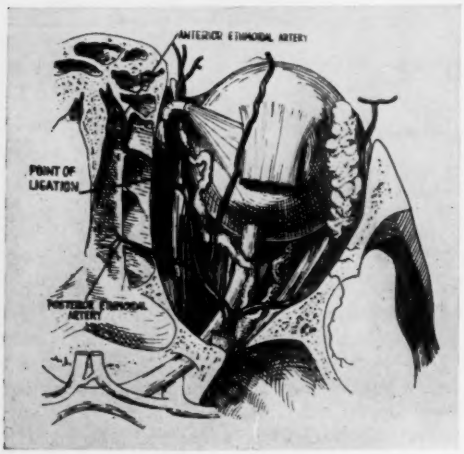
Immediate investigation of the operative site showed some slight oozing, but, more important, no ligatures and no artery stump on the medial wall were seen. Apparently, the ligature had slipped off the stump, the artery had retracted within the periorbital covering, and bleeding was taking place behind the eyeball. Pressure was applied with packing in the cavity. The bleeding was controlled. The incision was closed and a pressure dressing applied.

Subsequent observation showed the proptosis slowly subsiding. The patient was discharged July 28— apparently cured.

COMMENT

Nasal hemorrhage may be due to a large variety of causes. It has been customary when all medical procedures fail to ligate the external carotid artery.

Fig. 9.—Point of ligation of anterior ethmoidal artery. (Reproduced with permission from Weddell, G., and others: Brit. J. Surg. **33**:387-392 [April] 1946, Williams & Wilkins Company.)



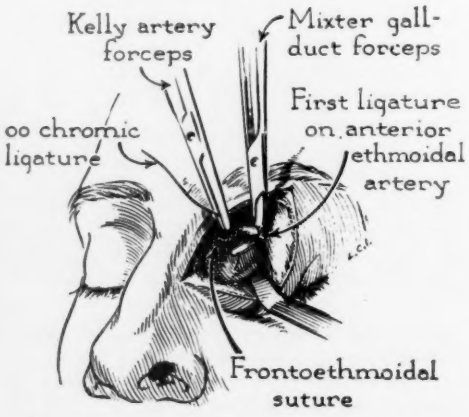


Fig. 10.—Exposure and ligature of anterior ethmoidal artery. (Reproduced with permission from Peluse, S., and Fishler, H. W.: A. M. A. Arch. Otolaryng. **60**:74-79 [July] 1954, American Medical Association.)

By observing whether the bleeding arises above the level of the middle turbinate, ligation of the anterior ethmoidal artery is probably sufficient to stem bleeding.

An unusual development of proptosis occurred after ligation and section of the vessel between ligatures.

In view of this possibility, it may be better not to section the vessel between ligatures, since the ligature may slip, causing retraction of the cut section into the orbital cone and continuation of the bleeding.

SUMMARY

The blood supply of the nasal mucosa is discussed.

The anatomical distribution of the ethmoidal vessels is demonstrated with the surgical approach to the control of bleeding.

A suggestion is offered not to section the anterior ethmoidal artery after ligation.

Miss Almena Pashby, librarian at the VA Hospital, helped in obtaining access to the literature, and Mr. Allen Weinberg, Medical Illustrator, helped in preparing all slides.

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RECURRENT SWELLING OF THE TONGUE DUE TO CIRSOID ANEURYSM (ANGIOMA)

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SWELLING of the tongue often presents a difficult problem in diagnosis and, consequently, treatment. The usual conditions considered in a differential diagnosis such as trauma, allergic states, infection, or neoplasm are usually readily evident and will indicate the treatment of choice. It should be added that systemic diseases such as cretinism and acromegaly should be kept in mind as being associated with macroglossia. Less obvious, and often puzzling, are cases where the tongue swelling is periodic and recurrent but transient in character. In the interval between attacks of swelling, the tongue appears relatively normal.

Among the noninfectious and nonmalignant conditions causing enlargement of the tongue, the angiomas represent a group of special interest and significance. Although not infrequent in the skin and mucosa, they are relatively rare when confined to the tongue. Various details of their clinical manifestations and pathological nature are still obscure. Every new report about such enlargements is of importance and interest. Greater familiarity with the character of this growth will lead to progress in its proper management.

The following is a case report of a curious clinical course which proved to be due to a rather unusual type of blood-vessel involvement.

REPORT OF A CASE

A Caucasian girl, aged 12, was awakened suddenly early in the morning by a marked swelling of the tongue. The condition was alarming in that she reported difficulty in breathing, swallowing, and talking. She was seen as an emergency and on examination presented a tense, smooth swelling of the left distal half of the tongue, which protruded outside the mouth and could not be retracted or pushed back. The swelling was sharply limited by the medial ridge and reached backward to the circumvallate papillae, immediately beyond which was normal tongue tissue. A few small submucosal petechial areas were seen on the undersurface. The taste buds over the swollen area were tense and dark red. The skin overlying was intact and pale pink due to the tension. The larynx appeared uninvolved. Her other physical findings, including a complete blood cell count, were entirely normal. The patient was placed on diphenhydramine (Benadryl), and the swelling subsided slowly. At the end of five days the tongue resumed its normal appearance and size. She was well until four weeks later, when the tongue suddenly swelled again to alarming proportions. This time a low-grade fever was noted and she was given chlortetracycline (Aureomycin). Again the swelling disappeared entirely in about a week.

In the following six months, the patient experienced four similar episodes of marked sudden swelling of about a week's duration, followed by complete subsidence. During the latter attack various other medications were given, including cortisone, but it was obvious that none of them had any specific influence on the process.

During her last attack of swelling, an 18-gauge needle was inserted into the mass and about 3 cc. of bloody material aspirated. A 2-cm. incision was then made through the skin on the undersurface of the tongue, and by blunt dissection a cavity within the body of the tongue was encountered. The resulting bleeding was profuse but could be controlled by manual pressure. An attempt was made to obtain a biopsy specimen by the use of a punch forceps, but little except fibrin shreds and clotted blood resulted. Finally a section of skin including the wall of the cavity was removed. The interior of the cavity was explored with a curette and the contents and wall lining removed as much as seemed practicable. The incision was closed with a black nonabsorbable (silk) suture, a small Penrose drain being inserted at one angle of the incision. Sutures and drain

Submitted for publication Jan. 31, 1955.

were removed three days later. The swelling gradually subsided and has shown no further recurrence in the past five months. It is felt that the curettage of the hemangiomatous cavity may have been adequate to destroy the tumor.

Micropathological examination of the specimen revealed the submucosal tissue as the seat of dense fibrosis, which extended in broad trabeculae into subjacent muscle. Study showed that the fibrosis had associated with it numerous large vascular channels which were collapsed into slit-like clefts, the fibrous tissue being apparently organized around these vascular sinuses. This appeared to be of the nature of a cirsoid aneurysm, that is, a collection of large, thick-walled blood vessels, rather than a typical hemangioma, the pattern for which was lacking. Although there appeared to be some fibrosis of the muscularis, that is, not part of the vascular channel wall, most of the fibrosis did have this relationship. Several pieces were partly covered by squamous epithelium which were not neoplastic. The diagnosis was cirsoid aneurysm of the tongue.

COMMENT

Cirsoid aneurysms is a curious involvement which in a true sense is not an aneurysm, although it is best known under that term in English and American medical literature. We find the first description of this condition in Virchow's article (in 1854) "About Macroglossia and a Pathologic New Form of Striated Muscle Fibres." It was classified by Virchow among the tumors of blood vessels and called *Rankenangiom,* or *angioma artériole racémosium.* It is probable that under the term have been included lesions which primarily originated either as an aneurysm by anastomosis or from the transformation of a true cavernous hemangioma.

A great variety of angiomas or aneurysms have been quite unnecessarily described, according to Boyd. An angioma is a tumor consisting of newly formed blood vessels. Frequently, however, it is difficult to say if a collection of vessels is a true neoplasm or merely a dilatation of previously existing vessels (telangiectasis). For our purpose two forms of hemangioma, capillary and cavernous, may be recognized.

The capillary angiomas are commonly known as port-wine stains, birth marks, or strawberry marks. It is generally present at birth. The favorite position is the face or head, where it often follows the distribution of the fifth nerve, and it is almost always unilateral, stopping short at the midline.

Cavernous angiomas are composed of erectile tissue. The common site is the liver, but it is also found in the skin and mucous membrane, where it may infiltrate the subcutaneous tissue and underlying muscle. Alarming hemorrhage may result from an ill-advised attempt at removal in such a case.

Cirsoid aneurysm is a form of cavernous hemangioma. It is a peculiar condition in which there is a mass of dilated and anastomosing vessels, each of which may possess numerous pouches. The corresponding veins are also involved, sometimes forming true arteriovenous aneurysms. The condition, which usually develops early in life, is progressive, and may recur when the vessels have been excised. From these characteristics it is evident that the condition is more closely allied to a neoplasm than to an aneurysm. The commonest site is the scalp. In this location the entire scalp resembles "a bag of worms."

The mode of development of these tumors is still uncertain. The most prevalent theory is that the primary growth is a new formation of blood vessels from a congenital anlage. Another theory is that the lymph or blood spaces in the tongue enlarge as a result of inflammatory or traumatic influences.

It is of interest to note that the formations show in the tongue a predilection for places wherein the embryological development fissures were present and subsequently closed. The line of fusion between the anterior and the posterior anlage of the tongue is marked in the adult by a V-shaped furrow along the line of the circumvallate papillae, in the apex of which lies the foramen caecum. It is noted that the usual site of these tumors lies within the limits of these fissures, as was illustrated in this case. The fissures are often noticed in childhood but remain small for a long time and then suddenly are exacerbated, usually as a result of an inflammatory process, after dentition, or before puberty.

The periodic swelling of the tongue in this patient brought up the consideration of possible vicarious menstruation, which may manifest itself at the onset of puberty. Endometrial rests have been found in various parts of the body, including the oral cavity. The onset of the tongue swelling at the time of puberty and its approximate monthly regularity were suggestive. However, no evidence of endometrial tissue was found in the biopsy section, but hormonal factors cannot be ignored entirely.

Treatment of cirsoid aneurysm is largely surgical and is directed to destroy or minimize the mass. Although surgical removal is the method of choice, it should be noted that massive bleeding to the point of endangering the patient's life has been recorded in past attempts in eradicating the aneurysm. Preliminary ligation of the lingual artery or, in more extensive cases, ligation of the external carotid artery should be considered.

Electrocoagulation by single or multiple applications would be indicated where surgical removal is not practicable.

Injection therapy of cavernous hemangiomas, whatever be the sclerosing fluid, is at times necessary for lesions of the tongue and in the nasal sinuses. It has been advocated by Pack and Miller as a preoperative procedure in cavernous hemangiomas to reduce hemorrhage at operation. Injection of a cirsoid hemangioma with sclerosing solution may cause necrotic ulcers. Injection therapy of hemangiomas does not necessarily require intraluminal injection. It is at times safer and just as effective to inject the sclerosing solution into the perivascular spaces, thus setting up an inflammatory process which causes fibrosis and resulting obliteration of the vascular spaces by the sclerotic connective tissue. The chief objection to the injection therapy is the temporary indurated and tender mass it creates, and which is, at times, quite alarming to the physician and the parents of the patient.

Radiation therapy is contraindicated because the dosage required to cause sclerosis is sufficient to cause radiation sequelae, such as keratosis, atrophy, and carcinoma.

SUMMARY

A case of recurrent swelling of the tongue due to cirsoid aneurysm is presented. Clinical aspects, pathogenesis, and treatment are discussed.

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Clinical Notes, New Instruments and Techniques

RETRACTORS FOR RADICAL ANTRUM OR TRANSANTRAL ETHMOSPHENOIDECTOMY OPERATIONS

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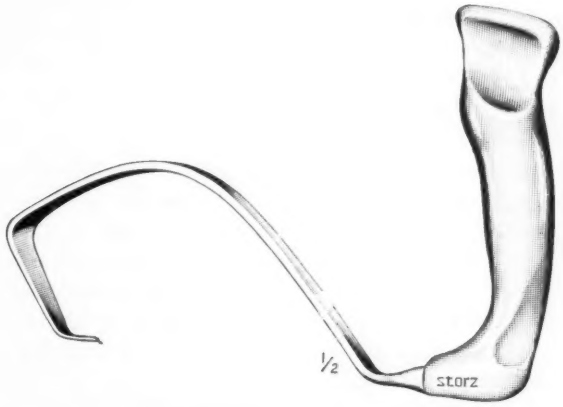
Proper retraction and exposure are of utmost and vital importance to the successful completion of any operative procedure. The instruments that have been used in the radical antrum and transantral ethmosphenoidectomy operations have frequently failed to give adequate and sustained retraction. In addition to giving poor exposure, the usual right-angled retractors repeatedly slip, requiring reinsertion, and cause a great deal of unnecessary soft-tissue trauma, with subsequent postoperative edema and ecchymosis.

In performing operations in the region of the antrum, if the procedure is of any duration, assistants holding retractors are apt to become fatigued, and with it again subsequent slipping, loss of exposure, and tissue trauma.

These new retractors have been devised in order to obviate these difficulties. They have been constructed so that the maximum point of retraction is at the tip of the retractor which would be placed just under the periosteum; and special handles have been attached so that an assistant may hold them securely in place without tiring. They are particularly suitable for transantral ethmosphenoidectomies where it is unusually difficult to expose the area between the infraorbital nerve and the nasal bone in approaching the bulla cell and the anterior-inferior portion of the ethmoidal labyrinth.



Retractor suitable for use in radical antrum or transantral ethmosphenoidectomy operations.

These retractors are constructed of stainless steel, and are indestructible, and easy to keep clean. The curves of the retractors have been designed at two angles in order to suit anatomical variations. Clinically, these retractors have proved to be of good use and serve a particular need. They may also be of service in procedures about the maxilla and jaw to the plastic and oral surgeons.

Grove Hill Clinic.

Submitted for publication Feb. 7, 1955.

Retractors are available at Storz Instrument Company.

Progress in Otolaryngology

FUNCTIONAL EXAMINATION OF HEARING

Summaries of the Bibliographic Material Available in the Field of Otolaryngology

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INTRODUCTION

MORE AND more the field of functional tests of hearing is being dominated by the acoustic physicists, who have the advantage of laboratory and mathematical equipment far beyond that which is ordinarily found in the office of the practicing otologist. It will be our effort to glean such information as seems of practical use to the otologist, to whom hearing tests are an important, but smaller part of the whole field.

The American Medical Association has discontinued the practice of issuing a monthly list of hearing aids approved by them. It is believed that the hearing aids now on the market are of such quality that this is no longer necessary.

HEARING AIDS

A preliminary study of the hearing aid in use was made by Kodicek and Garrard,[1] of the Ear, Nose and Throat Department of St. Thomas Hospital. One hundred patients wearing Medresco hearing aids for various types of deafness were tested over the frequencies 500 to 2000. They all had losses over 35 db. Less than 60 db. was classified as moderate loss of hearing; above that as severe (65 patients). Intelligibility was considered good if the patient understood all that was said. Ability to hear most of the conversation was classed as average; ability of those requiring repetition was classed as poor.

Recorded for publication March 24, 1955.

Over half showed good intelligibility, 87 falling into Groups 1 and 2. As expected, the nerve deaf and senile groups had less satisfactory reception than those in the conduction deafness group. Forty-eight were in paid employment. Of the under 33 age group, 20 used their aids at work. Those doing heavy work and those doing kitchen work and cleaning criticized the weight of the batteries and complained that the leads hampered free movement. Most of the patients used their aids at the cinema and for television. The perception deafness group used their aids fewer hours per day, and there was a tendency to use them less with increasing age. It seemed though that the elderly were enabled to reenter family life, from which they might otherwise have been excluded.

The authors expect to investigate in further detail the relation of social contacts of the elderly deaf.

Compressive correction of hearing-aid output by means of interchangeable resistors is suggested by Neuberger[2] in cases of cochlear deafness with recruitment. Conductive deafness is easily corrected by simple amplification; retrolabyrinthine nerve deafness is refractory to compensation; cochlear deafness poses a particular problem of hearing-aid selection due to the recruitment phenomenon. Peak clipping is one of the possibilities of elimination of excessive loudness, but may lead to distortion and loss of intelligibility. Dutch "Phillips," and "Vienna" hearing aids permit the interchange of standard resistors.

The eyelid blink response as a test of hearing was investigated by Galambos, Rosenberg, and Glorig.[3] Being objective, this is a preferable test. It depends on an involuntary signal that sensation has reached

the brain. A click of measured decibels was made audible through phones, and a sensitive crystal pick-up reacted to the movement of the eyelid. The subjects were all tested on the conventional audiometer. In general, the tests show that the "blink" threshold is about 50 db. higher than the threshold for acuity for sound. The test is of doubtful validity for testing the hearing but is recommended as a test for hysteria and malingering.

Day [4] presents a philosophy for the hard of hearing which he has acquired as a result of his own experience. He states that one should accept his deafness as an incontrovertible fact and acquire the determination to overcome the disability that it causes. He should get a hearing aid and wear it continuously as a part of his clothing, be attentive and use the eyes and brain to help him hear, develop a sense of humor about his deafness, avoid situations where acute hearing is essential, so as not to feel conspicuous, and avoid the antisocial tendency of the hard of hearing.

REHABILITATION AND CONSERVATION OF HEARING

In an audiometric testing of 2550 pupils in the municipal schools of Copenhagen, Denmark, Falbe-Hansen [5] found that 295 had hearing defects; 21.7% were due to defective perception; 78.3% were due to defective sound conduction.

In the socially poor sections there were 15.5% of pupils with hearing defects; in the more favorable sections only 9.7%.

Methods and clinical applications of speech audiometry as practiced in Finland are presented by Tauno Palva.[6]

This monograph covers in detail a survey of speech hearing tests, including speech reception thresholds, review of articulation tests and their clinical value; evaluation of pure-tone audiograms in terms of speech hearing; the author's own investigations in pure-tone audiometry, including detailed technique, recruitment and tinnitus measurement; his methods of speech audiometry; tests on hard of hearing patients with various types of deafness and including those with labyrinthine fistulae, and the effect of these impairments on the intelligibility of speech. He then goes on to an evaluation of speech audiometry as to correlation with pure-tone audiometry in which he considers the Fowler-Sabine percentage of hearing loss and the S. R. T. (speech reception thresholds), evaluation of the measured S. R. T. as to consistency with the theoretical S. R. T. according to Fletcher, average all-conduction impairment in the most important speech range and its correlation with the measured and theoretical S. R. T., loudness recruitment and its effect on the intelligibility of speech, the influence of tinnitus on speech hearing, and the importance of speech audiometry. After recounting the advantages and shortcomings of the various methods, the author stresses the importance of speech audiometry chiefly in prescribing hearing aids, in selecting cases for fenestration and evaluating results of treatment, and in determining loudness function in cases with some air-conduction loss in both ears. He concludes that pure-tone and speech tests supplement each other and give a more complete picture of type and degree of hearing loss than either test gives alone.

Perceptive high-tone deafness in children is commoner than is usually considered, in the opinion of Johnsen,[7] of Copenhagen, Denmark.

In a group of children it was found in 63 boys and 48 girls. This is about the usual proportion in all types of deafness. None of these had attended schools for the deaf, but half of them were in a special hearing school. (The abstracter infers that in Denmark there are two classes of schools according to the degree of deafness.)

The hearing was considerably impaired in the whispered voice test, but fairly good for the spoken voice. Audiometrically there were three groups: sudden curve downward toward the high tones, more gradual descent, and those with loss in the entire range. There was no quantitative difference between boys and girls, nor in different age groups. Ap-

parently this condition does not progress during school age. Nearly all the children had normal vestibular function. About half had speech defects consisting mainly in omissions and substitutions of consonants.

The children had difficulty in distinguishing between the tone and rub sound of the monochord.

Correlation between deafness and speech defects is discussed.

Fowler and Basek [8] made a study of permanent deafness in children under 5 years of age. This was made from charts of 270 children, half of these from the Vanderbilt Clinic. Fifteen cases had total or nearly total deafness in one ear, with normal hearing in the other. Eight followed mumps, three from measles, two from fractures of the skull, and in two there was no known etiology. The remaining cases had a 30-db. loss or more for the critical frequencies in the better ear. Eighty-one cases had deafness due to prenatal causes. Preconception causes are hereditary deafness, the commonest being retinitis pigmentosa and syphilis. Rubella and the Rh factor are the two important causes during pregnancy, the next common causes being anomalous growths and malformations and emotional causes, as evidenced by excessive vomiting during pregnancy. The important cause during labor was birth trauma. Of the postnatal causes, otitis media of the various types made up the largest group: 45. The infectious diseases made up the second largest group (39), with measles (14), meningitis (10), mumps (8), and status febrilis (7) as the four causative conditions. Drugs and poisoning produced eight cases. Many of these children have other problems besides deafness. The otologist with the pediatrician should be able to give proper counsel to the families of these children.

Heller and Lindenberg [9] present an outline for auditory rehabilitation in private practice. They feel that the otologist has the primary responsibility for the diagnosis, treatment, and rehabilitation of the hard of hearing. Hearing aids form an integral part of the rehabilitation and must be available to the otologist. Clinical auditory rehabilitation must be planned to meet the patient's needs. Hospitals, universities, schools, leagues, and private practice are all a part of a system of proffering medical service. Private practice of otology and clinical auditory rehabilitation belong to this system.

Guilford [10] presents a plan, set-up, and procedure for hearing rehabilitation work which can be employed in private practice. This program includes the services of an audiologist. The otologist-audiologist team is able to diagnose the hearing handicap on the basis of the pathology present and advise the patient as to the best therapy and to administer that therapy. The services described can be available in medical centers on a private basis with the audiologist working in conjunction with one otologist, or in a rehabilitation laboratory sponsored and directed by several cooperating otologists in a medical building. This approach permits the otologist and audiologist to participate as a team in this interesting practice of hearing rehabilitation.

Pattee [11] made a complete survey of the hearing centers in the United States. This report gives information on 134 centers. He has classified and tabulated the services offered by each center. This is a very valuable and informative reference table and should be in the possession of every otologist.

Fox [12] discusses the role that the interested otologist can and should take in the properly conducted conservation program. His observations and recommendations are based upon personal experience with hearing-loss claims brought before the Wisconsin Industrial Commission. The otologist is well suited to play a key role in the industrial hearing conservation program. He can give advice on the tailoring of a practical program of hearing conservation to meet the needs of a particular plant, on the selection of a suitable room for the hearing tests (preferably one with an over-all noise level below 50 db.), and on the selection of the audiometer and the checking of its performance. He can also instruct and guide the plant

personnel in the conduction of the tests. He can evaluate the preemployment and periodic hearing tests, and properly place workers with impaired hearing. If protective ear devices are to be used, he should supervise the selection and the fitting of these. He can perform tests to determine susceptibility of individual workers to occupational hearing loss. He can also detect malingering or exaggerations of all sorts.

The otologist also plays an important role in the medicolegal aspects of hearing claims. He has been asked to render opinions on several thorny questions, such as at what level of sound intensity and over what period of exposure hearing damage takes place. Generally speaking, high-frequency sounds are more damaging than sounds which liberate the same energy within a narrow band of frequencies. He must know the status of the employee's hearing at the time of employment. He should know what tests to use and what formula to use to evaluate the hearing-test results in terms of percentage and hearing disability. Calibrated speech audiometry in the hands of skilled practitioners is the test method of choice, and it is believed that for medicolegal purpose speech audiometry will soon supplant pure-tone audiometry with the sanction of the National Authoritative Professional Societies. The pure-tone audiometry now primarily used will be used as an adjunct to the calibrated speech audiometry. He should know when a hearing loss is considered permanent. At present a loss caused by prolonged exposure to loud noise may be considered as permanent six months following complete removal of the person from the area of loud noise.

Fox also gives the plan for setting up a program including a study of noise levels in the working areas, setting up a room for testing, necessary medical records, instruction to the personnel, and the review and evaluation of the results by the otologist. The worth of the otologist's contributions to the program can be judged by the extent to which he helps to achieve these major objectives: "to conserve the hearing of workers, to avoid unnecessary economic loss to the employer, and to collect the facts and data which will enlarge our knowledge of the defects of industrial noise and how they can be overcome." The otologist should remember that this is a joint effort requiring the cooperation of workers and management and of the medical and allied professions. Fox hopes that more otologists will interest themselves in attempting to overcome the effects of industrial noise.

Rüedi [13] presents an extensive report on experiments with exposure of the human and the animal ear to pure tones and noise. From his histological findings he concludes that pure-tone trauma and noise trauma are different forms of acoustic trauma. In the first stage of noise trauma, as in pure-tone trauma, the transition of physiological fatigue to pathological fatigue or stimulation deafness occurs abruptly above an individually varying critical intensity for white noise. Noise stimulation deafness is characterized by the following findings: A wide dip encompassing two octaves between 2000 to 8000 cps, with the maximum occurring between 4000 and 6000 cps. A narrowing of the difference limen of a test tone within the dip (4000 cps). A delayed recovery of the threshold of tones in the region of the dip. An increase of the difference limen of a second 1000 cps, that is, a tone from the frequency range immediately below the noise dip. A lowering of the threshold for the second test tone 100 cps. The stimulation deafness varies individually with the individually varying critical noise intensity.

McLaurin [14] discusses the problems of the inarticulate child and the problem it presents in diagnosis. More of these children are being referred to the otologist than before because they are more prevalent due to their ability to survive with the advent of improvements of therapy, such as the antibiotics. The usual methods for testing these children are not suitable for diagnosis. Instead, a careful detailed history, clinical observation and evaluation, and, last of all, laboratory

investigation are necessary for a diagnosis. The author presents a technique of history taking, auditory testing, and clinical evaluation of the total child. The use of noise makers in a free field, determining the presence of hearing by the cessation of any activity that the child is doing, is a desirable method for testing young children because it can be done unobtrusively in natural circumstances. The approach to this problem must take into consideration that both the child and his parents are in distress and need all of the physician's understanding and compassion in addition to his technical skill.

Walsh [15] studied the progress of hearing after pregnancy in 110 women who had been operated on for otosclerosis. He found no evidence that pregnancy has a significant effect on the deafness of otosclerosis. In view of these findings there should be no excuse for advising a therapeutic abortion in a woman with otosclerosis.

HEARING TESTS

Shapiro [16] discusses the minimum hearing test requirements for office practice. The techniques employed by audiologists and research otologists are for the most part neither practical for private practice nor essential to a diagnosis in the average case. The otologist having limited time and lacking technical help should rely upon a thorough tuning-fork examination supplemented by an air-conduction audiogram and one of the three methods for testing speech hearing. The tuning-fork tests should include the Schwabach, Weber, and Rinne tests, ascertaining the upper and lower tone limits and the amount of impairment of hearing for the various forks starting at C_{16} at octave intervals to C 4096. Carefully performed tests with a reasonably complete set of tuning forks will give an accurate qualitative diagnosis of a hearing impairment. An air-conduction audiogram should be a part of the examination for every patient complaining of or suspected of an impairment of hearing. It gives the otologist a record which can serve for comparison with similar future records. Although useful information can be obtained with the bone-conduction oscillator, the writer feels that his requirements in this respect are adequately taken care of by the tuning-fork examination. The recruitment tests are of value in the fitting of hearing aids and in differential diagnosis. However, they are time-consuming and have no place in the routine examination of a busy otologist. A test for speech hearing should be included in the routine examination of the hearing of the patient. This may be the monitored live voice test, the use of recorded voice, or the unaccentuated whisper test. Details for carrying out the various tests and a description of the equipment necessary are discussed in the article.

Bergman [17] reports another instance of otosclerosis in identical twins, bringing the total number of reported cases in the literature to 17.

Henner [18] studied the bone conduction in 72 cases of fenestration preoperatively and postoperatively. He got the impression that there was a slight gain in bone conduction, averaging 2.5 db. at 500 cycles, 8.7 db. at 1000 cycles, 8.2 db. at 2000 cycles, and 7.5 db. at 4000 cycles. Two types of cases primarily accounted for this gain: Class I patients, who have a markedly negative Rinne for 2048 cycles, are below 40 db. loss for air at 4000 and 8000 cycles and yet have 10 db. or better bone conduction at 4000 cycles. These often have a result better than anticipated. Class II patients have dips in bone conduction at 1000 or 2000 cycles. These often have an unexpected excellent air-conduction result and simultaneously show bone-conduction improvement at these dips, especially if the postoperative result was better than a 25-db. average for speech. Bone conduction improved in about 50% of the Class I cases in which the postoperative result was better than a 25-db. average for speech. In Class I cases the prediction technique has the greatest variability. The variability of results, ± 10 db. at a 23-db. average for speech frequencies, does not merit using a bone-conduction factor or making an exact

prediction. In Class II cases, with all other findings indicating an ideal case with relatively good air conduction in the upper frequencies, good bone conduction at 4000 cycles, and excellent speech discrimination tests, the bone conduction usually improves and successful hearing may be predicted. In these cases the use of the Carhart notch subtracted from the preoperative bone-conduction measurements is valuable. In Class III cases, where the predicted result is 36 to 40 db., the bone conduction may improve similarly to that in Class II, but the resultant hearing gain does not merit widespread surgery. The prediction of results in general with these qualifications taken into consideration can be of value in classifying cases for the surgeon and helpful to the patient in understanding the type of hearing he may expect.

A classification of so-called congenital deafness is offered by van Egmond.[19] He says that deafness may be congenital but not hereditary, as in deafness caused by rubella during pregnancy; hereditary but not congenital, as in otosclerosis. It may be both at the same time, as in sporadic recessive deafness. There are two types of congenital hereditary deafness: dominant hereditary and recessive sporadic. A deafness developing at middle age is present in every generation in 50% of the offspring.

After describing in detail the instrument and technique of testing with the psychogalvanic skin responses, Goldstein, Ludwig, and Naunton [20] come to the conclusion that their results were often demonstrably misleading, and in this respect have no advantage over current techniques. Forty-two children were tested. There were two groups: In one the children were conditioned and cooperated after two or three presentations of the tone shock combination and responded to audible tones throughout the test; in the other group the children were conditioned only after many presentations of the tone shock combination and continued to respond for only a very short time.

The psychogalvanic skin response tests may confirm a clinical diagnosis of communication disorder other than peripheral deafness.

Psychogenic deafness is discussed by King.[21] He classifies psychogenic deafness as follows:

1. Functional
   - A. Loss of discrimination or faulty discrimination, as in elderly people
   - B. Organic deafness with hysterical overlay
   - C. Pure hysterical deafness with no evidence of organic defect
2. Malingering
   - A. Associated with hysteria
   - B. Malingering with organic defect
   - C. Simple malingering

Type 1A may be found in elderly people who have lost the discriminative capacity of listening to what they want to hear in the background sounds of everyday life. Their hearing tests may be approximately normal. They are unable to concentrate. (Two cases are described, both military.)

In Type 1B there may be organic deafness with a hysterical overlay.

In Type 1C there is pure hysterical deafness, usually in persons with poor mentality, poor education, and ebbing morale.

A sudden onset of deafness not coinciding with normal clinical history should make one suspect hysterical deafness; the demeanor of the patient, test results that vary from day to day, and inconsistent fork tests may also be indicative of hysterical deafness.

The author discounts anesthesia of the external meatus as having differential diagnostic value.

The author also tried introducing noise interference up to the reception of speech level.

Psychogenic loss is suspected

(*a*) When speech reception is inhibited by noise level less intense than previously measured speech reception level.

(*b*) If noise perception threshold is lower than speech perception level.

(*c*) Where there is marked discrepancy between speech thresholds.

The author had no success with the galvanic skin test and electroencephalogram. His opinion is that if there is an abnormal caloric test one is dealing with organic not hysterical deafness.

Examples are given of various types, and early recognition and treatment are advised.

In malingering he favors the Lombard and Stenger tests, checking and rechecking audiometrically. He also mentions the two stethoscope tests.

Under the title of "Sound Transmission in Clinical Otosclerosis," Rytzner [22] devotes 112 pages to a study of sound transmission during the progress of the fenestration operation at several stages. Included in the analysis were 10 normal hearing subjects and 77 with clinical otosclerosis. Tests were made on the normals before and after blocking the external canal at the tympanic membrane; similar tests were made on 34 cases of clinical otosclerosis on the day before fenestration. On 31 of these, tests were made during the operation at the following stages: immediately before operation; after surgical enlargement of the external canal and middle ear; same, with round window blocked by fluid; with small fenestra, endosteum present; same, endosteum removed (16 cases); completed fenestra, endosteum present; same, endosteum removed; same, with round-window niche blocked with fluid; with skin covering fenestra (16 cases) at completion of operation (ear not operated on), 14 cases.

Air-conduction thresholds were obtained on 43 cases with healed fenestrations before and after blocking the round window with dry cotton, fluid, and oxycholesterol-petrolatum (Aquaphor) ointment.

Blocking with fluid at the membrane in normal ears decreased hearing by air conduction at all frequencies; bone conduction was improved at 250, 500, and 100 cps. In clinical otosclerosis a small decrease was demonstrated by air conduction and no changes were obtained by bone conduction. The author concludes that in stapes ankylosis air-borne sound conduction is by way of the round window; if the loss is over 60 db., air-borne sound is probably conveyed to the labyrinth by bone conduction.

Other conclusions were the following: Improvement in hearing is greater with a large fenestra; a minor but significant improvement is obtained by removal of the endosteum; with the incus and head of the malleaus removed and before fenestration proper there was a slight decrease at the extremes of frequency range. Maximal improvement is achieved at the time the fenestral opening has reached its maximum size and the endosteum is removed. On the other hand, when the skin flap was placed over the completed fenestra no significant shift in pure-tone thresholds could be demonstrated.

In regard to preoperative medication, a decrease in hearing following administration of morphine and pentobarbital (Nembutal), significant only at 125 and 250 cps, was found. Relative thresholds appear sufficiently valid to allow comparison of acuity at different surgical stages.

Hearing loss in multiple sclerosis is discussed by Winfried.[23] The audiograms show hearing loss essentially in the lower and higher frequencies, with somewhat of a hump of better hearing in the middle frequencies.

The audiologic findings in syphilitic inner-ear damage are not diagnostically characteristic, according to William Wagemann,[24] as shown by a series of graphs. There was considerable variation in the ability to hear from time to time in some of the patients. The recruitment phenomenon was not constant, and appeared to be reversible in some patients, and some of them seemed to improve with penicillin and iodide therapy.

The masking effect of pure tones as well as complex noises on pure tones was studied by Pestalozza and Calearo.[25] Their results confirmed the large masking influence of frequencies below 500 cps. In speech audiometry an unfavorable intelligibility curve for spoken words with a decreasing curve toward the higher pitches may be due to the masking effect of the still well-heard lower frequencies. The influence of the higher harmonics of the low-frequency tones seems to be important for good speech perception.

A test to reproduce paracusis Willisii by introducing a masking noise and pure tones at the same time is described by Seelenfreund.[26] In true otosclerosis the threshold changes only 10 to 15 db., but is changed considerably in other types of deafness.

Hearing loss after mastoidectomies was measured on 19 cases by Riccabona and Jezek.[27] Nineteen patients were operated on a second time for recurring mastoiditis. Postoperative hearing was normal in 6, while 13 had a gap at c-5. In this group operation revealed extension of suppuration to cells around the labyrinth.

Loss of hearing following administration of dihydrostreptomycin is described by Lidén.[28] In six cases of pulmonary tuberculosis the Békésy audiometer showed hearing loss with complete recruitment. This shows that the damage of streptomycin primarily affects the end-organ. In 18 cases of tuberculous meningitis recruitment was absent in 3 with loss of hearing.

Metz[29] says the diagnosis of patulous Eustachian tube, a rare condition, can sometimes be established by movements of the tympanic membrane synchronous with respiration by auscultation of the meatus; the sound of respiration, the amplification of a tone led through the nose, or the intensified voice of the patient may be observed. The patient often complains of a sense of occlusion of the ear. Treatment with a powder of salicylic acid, 1 part, and boric acid, 4 parts, gives immediate though temporary relief.

De la Rosée,[30] on the basis of auditory and audiometric measurements of 360 subjects, states that loss of hearing starts at 50 both in pure-tone audiograms and in whispered speech tests. The loss is progressive.

Auditory threshold measured daily on three subjects over a prolonged period of time by Wertheimer[31] indicated that the judgment of the subjects agreed with the findings better than could have been expected on chance alone. This suggests that the subject's understanding of the experimental outcome may influence his behavior.

Friedmann[32] believes that the so-called bone conduction probably goes by way of the skull, cerebral fluid, to the saccus endolymphaticus, thence through the aquaeductus vestibuli to the cochlea. The ductus endolymphaticus acts as a tympanic membrane, and with the aquaeductus vestibuli amplifies the vibrations. Localization of the sound of the tuning fork on the skull is explained by carrying over of vibrations through the fluid intracranial contents.

It is unlikely that the cochlea is stimulated directly by bone-conducted impulses, as a tuning fork placed on the squamous portion of the temporal bone is heard louder in the opposite ear.

(The abstracter was unable to confirm this latter statement in a few tests on presumably normal ears.)

A new method for testing hearing in temporal-lobe tumors is described by Bocca, Calearo, and Cassinari[33] in a preliminary report. It consists of using the monitored voice, filtering out frequencies above 800 cps, thus making discrimination poor even in the ear on the side of the lesion. In the vast majority of cases discrimination was much poorer in the ear contralateral to the brain lesion. It is assumed that the psychic integration of the verbal message is impaired. In these cases the usual hearing-test techniques did not disclose a difference in the two ears.

Schubert and Panse[34] find no deviation from normal or difference in the two ears with the ordinary hearing tests beyond more easily induced fatigue; but definitely diminished is the ability to concentrate, the correlation of spoken instructions with other psychic functions, the memory for spoken instructions, and the acoustic gnosis.

(This is interesting in connection with the above article by Bocca, Calearo, and Cassinari.)

Tomatis,[35] of Paris, states that an ear for music can be determined by the audiogram. It is indicated by a zone of relative hyperacousia between 500 and 2000 cps; the curve ascending from low to high tones with a difference varying between 10 and 20 db. is characteristic for musicians. All subjects giving similar curves were musicians or lovers of music, had sensitive hearing, and could reproduce a musical phrase correctly. The author claims that inspection of the audiogram is sufficient to establish whether or not a person is a musician.

Brandstetter and Koehler [36] describe hearing loss of combined character occurring in scleroderma. Disturbance of sound conduction is explained by the atrophic membrane tympani, rigidity of the ossicular chain and labyrinthine windows. The perceptive loss may be due to sclerodermic changes in the epithelium of the cochlea.

Davis [37] reports a case of progressive deafness associated with cleidocranial dysostosis. This is a congenital abnormality involving bones of membranous origin. The pathognomonic features are found in the skull, clavicle, and pelvis. The eyes are widely spaced, the nose is depressed at the bridge, the face is small, and the teeth show faulty eruption. The deafness may be due to the congenital abnormalities of growth of the cranial bones.

Childrey [38] reports his observation on 100 cases of perceptive deafness treated with large doses of amino acids, vitamin B complex parenterally, and histamine intravenously. These cases have been observed over a period of 10 years. They were tested before therapy and again on an average of 9 to 79 months afterward. The results were disappointing.

Juers [39] reports several cases of early end-organ deafness in which improvement in the hearing was obtained using relatively simple therapeutic measures. These cases involved young persons, in the second and third decades, with symptoms of rather sudden onset and of short duration. In some instances where both ears were involved only one improved, indicating that the lesion had progressed to a stage of irreversibility in that ear. One should not become too enthusiastic with any given therapeutic treasure because of the possibility of a spontaneous reversal of the lesion. The most important aspect of the general problem of early nerve deafness is a proper physiological approach to a wide range of etiological factors. Some theoretical observations are also made by the writer concerning the possible relationship of some features of cochlear anatomy and clinical observations on nerve deafness.

Goto and Yamada [40] propose a new hearing test above threshold to differentiate lesions of the inner ear from those of the hearing center. The test can be made at 20, 40, or 60 db. above threshold. The normal audiogram is first made and then the tone given 20 db. or otherwise above threshold. With this tone kept in mind by the patient, it is then given from 0 db. up to the point where the patient believes that it is of the same intensity. It is then decreased from 90 db. to the point where the patient again believes that it is the same intensity tested above threshold. The difference between these two is then recorded. Although this test is a kind of difference limen, it does not directly show a difference limen. From the various tests made they assume the following to be of clinical significance: Cases showing narrow ranges indicate a lesion of Corti's organ. Those showing normal ranges have either a lesion of the acoustic nerve, variations of labyrinthine fluid, or lesions both in the acoustic center and Corti's organ. Those cases showing a wide range have lesions of the acoustic center.

Onchi [41] describes his own method of performing the blocked bone conduction test with a plastic plug having a hole 1 mm. in diameter bored through its axis inserted into the external auditory canal. He found that the increased loudness in bone conduction obtained with the auditory canal blocked by a plastic plug is the same phenomenon as the decreased loudness in the Gelle test but opposite in effect. The threshold shift of bone conduction obtained by this test was not only available for detection of the dysfunction of the middle ear vibratory system but also for diagnosing nerve deafness. He was also able to differentiate central deafness by a combination of the blocked bone conduction test and Fowler's balance test or difference limen test. The test is made by placing a bone conduction receiver on the mastoid planum of the tested ear while the untested ear is masked with a thyratron noise. The bone conduction test tone is increased from an inaudible intensity to one which the ear is just able to

hear. The external auditory canal of the tested ear is blocked with a plastic plug perforated by a hole whose diameter is 1 mm. This reading is then checked and the plug is removed. Immediately after removal of the ear plug the test tone disappears in the tested ear, and after reinforcing the intensity of the test tone the second threshold is then obtained. The difference between the two tests in decibels is the numerical value which informs us as to the amounts of conduction hearing loss. These values will be about 20 to 30 db. in a frequency range of 200 to 300 cps and about 15 to 25 db. in a frequency range of 700 to 900 cps or, rarely, 1000 cps for pure nerve deafness or for normal ears. These values will, on the other hand, be reduced to less than 15 db. or frequently to 0 db. in cases of conduction deafness. This method will afford very accurate results even when the test tones are limited to the two frequencies 250 or 256 and 800 or 1000 (1024) cps.

The author found that the plastic plug had to have an opening of 1 mm. in diameter. The solid plastic plug producing an air-tight canal produced a positive air pressure in the auditory canal which affected the function of the tympanic membrane so that unproportionally small threshold shifts or no shifts of the blocked bone conduction were observed even in cases of normal ears. The ear plugs should be of various sizes to fit correctly each person's auditory canal. The blocked B. C. (bone conduction) curves are independent of any frequency characteristics of bone conduction receivers in cases of nerve as well as conduction deafness. However, they do depend upon degrees of conduction loss due to the disturbed middle ear vibratory system. The threshold shift of the blocked B. C. is inversely proportional to the degree of conduction loss, and it becomes in general 0 db. in conduction loss of above 30 db. It is inversely proportional to the disparity between air-conduction and bone-conduction curves in a combined type of deafness as well as in pure conduction deafness. The lowering or disappearance of the blocked B. C. curve due to a middle-ear lesion was frequently observed more markedly at the peak of about 800 cps than at the peak of about 200 cps. When the middle-ear lesion is slight, the peak of about 200 cps sometimes remains intact while the peak of about 800 cps lowers or disappears. Onchi's blocked B. C. test detects a conduction component of hearing loss alone. When normal threshold shifts are detected in a patient with impaired hearing, it indicates the loss due to nerve deafness, including central nerve deafness. The Fowler balance test reveals only a nerve component hearing loss, namely, a pathologic condition of the hair cells. Therefore, a differential diagnosis of nerve deafness cannot be diagnosed by these tests alone but by combination of the author's tests and Fowler's balance test or difference limen test.

Goodhill and his associates [42] utilized the psychogalvanic skin resistance technique as developed by Bordley and Hardy with several modifications. The equipment consisted of a source of electrical shock stimulation and the associated equipment to pick up the response from the patient and pass it through an appropriate amplifier into a recorder. The graph so obtained has been termed an electroaudiogram, or "EAG," by the writers. Some incomplete and variable records were obtained in some infants less than 20 months of age due to fatigue, emotional disturbances, or lack of maturation. There was also some difficulty in obtaining adequate electroaudiograms in brain-damaged children. However, this latter group exhibited several characteristic curves that are readily identifiable. The development of psychogalvanic skin resistance audiometric testing is a significant achievement in otology. The interpretation of the findings, however, is only valid when compared and evaluated with other types of auditory testing, such as the startle reflex and pure-tone audiogram. Although this is a nonsubjective test, it is not truly a completely objective one, and further search for such a test must continue.

Goodhill [43] has increased the usefulness of the startle reflex audiometric technique by adding attenuation and four corner speakers for directional responses by the subject.

These directional responses utilizing ocular or head movements give additional information and are very helpful in the testing of children.

Hoople and his associates [44] describe a method of masking air and bone conduction using irrigation of the ear canal as the masking technique. This was applied to a group of normal hearing persons and a group having a unilateral hearing loss. Water douche masking produces a masking effect of 90 db. by air conduction and 45 to 50 db. by bone conduction. Noise is not a significant factor in obtaining this effect. Water douche masking may be less likely to result in elevated thresholds in the unmasked ear than high intensity noise masking.

Fournier [45] describes the "false-Bing" phenomenon. In cases of pure unilateral conduction deafness of more than 30 db. and in 85% of all cases when one occludes the good or uninvolved ear the Weber remains lateralized to the bad ear. The occlusion of the good ear produces a significant shift of the bone conduction threshold of the bad ear objectively as well as subjectively. This phenomenon occurs only in pathological cases. It does not happen when one tries to simulate a unilateral pure conduction deafness by occluding one ear with the finger. In that case occluding the other ear will progressively reset the Weber in the center of the head. The Bing test and Weber test should not be considered as two different aspects of the same phenomenon. The Bing test produces a significant shift of bone conduction threshold on the low frequencies, while the Weber test in pathological cases does not. The Bing test can be explained by Békésy's hypothesis on the inertia of the ossicular chain, the effect of which is enhanced by the inertia of the head of the mandible vibrating in a closed canal. The Weber test is not explained by such a hypothesis. The "false-Bing" phenomenon shows that the Weber test remains unexplained. In unilateral pure condition deafness, the bone-conducted low frequencies are heard in the bad ear. Although we know for certain that the bone conduction cannot be better than in the opposite good ear, these findings have important practical significance. It is impossible in cases of unilateral pure conductive deafness to mask the bad ear in order to measure the bone conduction threshold of the good ear. The present methods of calculation of the amount of noise necessary to mask an ear do not take into account the fact that the bone-conduction curve of the bad ear may be lower than the bone-conduction curve of the good ear.

In a discussion of the conductive mechanism and recruitment, Markle [46] presents the hypothesis that recruitment may be an indication of a potentially reversible conductive lesion within the inner ear rather than a neural lesion. He discusses acoustic trauma, Ménière's syndrome, secondary nerve loss due to otosclerosis, and secondary nerve loss due to otitis media to substantiate this hypothesis.

Beebe [47] states that with the increasing use of the psychogalvanic skin resistance test for hearing in children there is a tendency to use this test alone as the basis upon which to judge a child's capacity to hear speech sounds, and points out that such a premise cannot be relied upon in determining the child's further education. The author maintains that the direct tone introduction test with Urbantschitch whistles is a measure of the capacity to hear speech sounds, while the psychogalvanic test refers only to pure tones. That the centers for the perception of complex (speech sounds) and for pure tones are different is generally conceded on theoretical grounds, but the author quotes two lengthy and detailed case histories to illustrate her point.

Huizing [48] discusses the influence of background noise on the hearing both in speech and pure-tone audiometry. In speech audiometry for normal persons at least a 20-db. intensity higher than the testing level is needed before false answers are given; the results also depend on whether low or high tone noise is used, and they also vary for different types of hearing impairment. The point is made that as the hearing function is ordinarily exerted against a background of

noise under modern conditions, this is a logical method for testing the hearing.

Halpern [49] comments on the well-known fact that the partially deaf hear better in the presence of noise, as first noted by Willis in 1672. Previous explanations are that noise may intensify the sensitivity of the acoustic apparatus. The author believes that the sense of vibration represents a function complementary to auditory perception. This is based on the fact that these two functions both deal with perception of vibration, as is indicated by facts gathered from phylogenesis. Paracusis Willisii is thus explained as an intensification of the hearing capacity through stimulation of the sense of vibration by concussions of the ground.

Hennebert [50] discusses the various factors which enter into the ability to hear the spoken word and which make it difficult to measure this capacity. Besides frequency and intensity, the fact that vowels and consonants involve mainly certain portions of the auditory spectrum, intonation and accent, rhythm, number of phonemes uttered per minute, and, finally, familiarity with the spoken material all play a part in determining the final result of a speech test. He reviews the original American Medical Association method as well as Fowler's method for computing the capactiy to hear speech from the pure-tone audiogram; he also discusses the present-day intelligibility tests with spoken words and states that the objections to all of these methods are sufficient to prevent their routine use by otologists. Hennebert has chosen to experiment with mixtures of tones which he claims give a remarkable similarity as to end-result with the more complex and time-consuming tests mentioned above. He used (1) a record of what he terms "between the acts" noise—the hum of many voices, tones, and intensities heard in the intermission of a play, (2) "white noise" of the type used for masking in the latest audiometers, and (3) "white noise" filtered in a special manner. These are measured by means of a pick-up, if necesary, to the audiometer and normal thresholds on different people established. After discussing the theoretical basis for his thesis, he states that a considerable number of tests on persons with different types of deafness have indicated a very close analogy between the results of intelligibility tests and tests by his method; the threshold in decibles thus achieved can also serve as a basis for computing percentage loss by means of the American Medical Association method.

Portmann and Portmann [51] discuss the detection of simulation by means of electroacoustic methods, dividing these under the headings of subjective and objective audiometry. Under the former they include (*a*) pure-tone tests, (*b*) speech audiometry, and (*c*) tests with masking noises. They state that in pure-tone audiometry simulators generally display a horizontal curve for both air and bone with a fairly fixed level for different frequencies. When, even, at the same examination, one jumps from a high to a low level frequency at different intensities from one ear to the other, using a double headband, different levels for the same frequency are obtained. In examining by means of speech audiometry, this is done with standard word lists, putting down the percentage of words heard correctly at certain intensities. One method is to compare the intensity of the speech heard with that of the pure-tone curve; another is to pass alternately from weak to strong intensities with different words until one obtains two responses at the same intensity which are incompatible, e. g., 0% and 100% (at differnt times), which will unmask the simulation. For tests with masking noises the first one is the Lombard; white noise is introduced by means of the double receiver with the patient reading into a microphone which is connected to a decibel meter, which shows the increased loudness of the patient's voice as it is raised under the influence of the tests. The Stenger is also used. Under objective audiometry the authors describe the psychogalvanic test but admit its limitations for this purpose, namely, that one cannot differentiate by this means malingerers from those with psychogenic deafness.

Lundborg [52] investigated 51 patients with acoustic traumata and Ménière's disease representing cochlear lesions and 21 brain tumors and other verified retrocochlear lesions for results of the difference limen test on the Békésy audiogram. He found that the former group almost without exception indicated a strongly diminished difference limen (recruitment) while the retrocochlear lesions showed a normal difference limen as a rule (no recruitment). He concludes that this test with the Békésy audiometer is a valuable addition to the usual cochlear tests. Representative audiograms are given.

This paper [53] is from the Hearing Clinic of the University of Bordeaux and describes the modern methods of diagnosing and treating deafness in children. Above the age of 7 years the tests used are the same as in adults subject to the greater fatigue and distraction which obtain in children. Between the ages of 7 and 3 conditioning techniques, such as the "peep-show" technique, are used; under 3 years only the psychogalvanic reflex technique gives some degree of dependability. With respect to the latter the authors find that the result is within 5 db. for the older child, within 10 db. for the child from 7 to 3 years, within 15 to 20 db. for the child from 3 to 2, and 20 to 30 db. for those less than 2; they find that it is very difficult to obtain responses from infants of less than 14 months. Vocal audiometry is used in the customary vision with a double room and the examiner attempting to obtain the intensity of the speech level by pronouncing the names of various objects at which the child, seated in a separate room, is pointing. Reeducation is conducted along lines familiar in this country with teachers using hearing aids, speech-reading methods, as well as other visual and auditory apparatus (phonaudioscope and bioscilloscope) for the purpose of bringing the speech and hearing of the children to the best possible stage. Instruction is begun about the age of 3 years, if possible.

This paper is an exposition of technical details followed by the authors [54] in over 300 examinations by means of the psychogalvanic reflex. It does not lend itself to abstracting but should be read by those who intend to examine hearing by this method.

The authors [55] review the methods for differentiating between perceptive deafness due to lesions of the internal ear and that caused by lesions of the central auditory pathways. On the basis of their experience, which in some instances was verified at operation or autopsy, they conclude that the recruitment phenomenon is limited to inner-ear lesions and thus gives a valuable differential diagnostic point in doubtful cases. Ten case histories with audiograms are included in the article.

NOISE

Hoople,[56] in a symposium on the problem of noise in industry presented before the Academy of Ophthalmology and Otolaryngology in October, 1953, gives a history of the advances and accomplishments made with this problem. The Subcommittee on Noise in Industry of the Academy has played an important part. It now has a field representative qualified in the field of audiology who travels considerably, aiding industrial firms in establishing conservation of hearing programs. The Subcommittee has its home base in Los Angeles, where it is carrying out various research problems. A curriculum has also been established to train nurses and technicians for industrial audiometry.

Wheeler,[57] the field representative of the Subcommittee on Noise in Industry of the Academy, discusses some of the problems which have to be investigated in this field. These are to learn how much, how long, and what type of noise will produce how much hearing loss in how many people; also, who is susceptible to hearing loss and how the ear can best be protected. From facts gathered it is believed that one person in four entering industry has some audiometric loss of hearing. This group, in addition to the 75% entering industry with normal hearing, also requires special protection to prevent further changes. Presbycusis must also be reckoned with when dealing with men who are working for a long time. Nonindustrial causes of deafness must also be taken into consideration.

From investigations being made data are being collected so that all these questions can be satisfactorily answered.

Nash [58] discusses his own personal experiences in dealing with the medicolegal aspects of noise in industry. He has observed occupational deafness as it occurs in heavy industry for a period of almost seven years, and he found that a significant percentage of employees permanently removed from many years' exposure to a noise level of 115 to 120 db. have shown an appreciable degree of improvement in hearing: in some employees after 6 months, others after 12 months, and in two after an interval of 18 months. The Compensation Commission of the State of New York understands the serious implications of the problem of industrial deafness and is considering the following compromises to satisfy all parties concerned.

> No award shall be made until some period after the claimant is retired or for other reasons leaves the employment of the company. At that designated time the audiometric plateaus obtained will be considered as levels representing permanent losses provided the claimant shows no evidence of simulating or exaggerating his deafness and providing some rectification factor can be used for the appraisal of non-traumatic deafness resulting from advancing age. Cash payments will be made promptly when the foregoing conditions are fulfilled.

The problem of noise in industry and its effect on hearing has added a new responsibility to the work of the otolaryngologist.[59] When testing for purposes of establishing compensation needs, he should be prepared to supply all the tests necessary for proper diagnosis. These should include pure-tone audiometry, air and bone conduction, tuning-fork tests, where necessary, and speech tests, using a speech audiometer. The testing room should have no more than 50 db. of ambient noise.

Harris [60] studied the roles of sensation level and of sound pressure in producing reversible auditory fatigue. A test was employed for screening fatigue-susceptible persons. Thresholds were first obtained on each subject at 2048 and 4096 cps. A fatiguing stimulus at 2048 cps was then led to each subject for five minutes from a Howlett-Packard oscillator connected to the audiometer earphone. The sound pressure level was maintained at 97 db. (equivalent to 80 db. above "normal" on American audiometers at this frequency). The stimulus was terminated by a two-way switch that immediately fed a 4096-cps tone to the earphone from the audiometer set at 20 db. above the person's threshold for that frequency. This tone was turned on and off in three-fourth second intervals, producing a pulsing or interrupted tone. As soon as the tone was heard at the 20-db. level, the subject tapped a microphone of a wire recorder and the experimenter reduced the tone 5 db. and waited for another signal. This was repeated until 0 db. at threshold had been recorded on the wire. In this way a complete picture of the recovery curve was drawn and recorded. Harris studied 66 cases and found that the sensation level governed by the subject's hearing at threshold is a more important parameter than the sound pressure level. This study revealed a more rapid recovery than was found previously reported by Wilson (Wilson, W. H.: Determination of Susceptibility to Abnormal Auditory Fatigue, *Ann. Otol. Rhin. & Laryng.* **59:** 399, 1950), who used the inability to hear a tone 10 db. over own threshold after two minutes' recovery as a criterion of fatigue. This study shows a better criterion to be either the time in seconds to return to within 5 db. of own threshold or the residual hearing loss after one minute. The use of a pulsing tone rather than a steady one is very important in determining threshold during recovery so as to minimize the irrelevant masking effects of the high-tone tinnitus, which very often follows stimulations such as used here.

MALINGERING

Glorig [61] discusses the subject of malingering and the difficulty one has in differentiating it from the hearing losses of psychogenic origin. To differentiate these one must obtain directly or indirectly an admission of intent to defraud. The unilateral malingerer

has been relatively easy to uncover with the classic Stenger test. Those simulating a bilateral hearing loss still present a very difficult problem. Speech reception tests give the otologist a new instrument in his fight against the malingerer. The pure tone speech reception relationship has been an important factor in ruling out a functional element. This relationship in all valid hearing tests is within 10 to 12 db. or better for the average threshold of 500, 1000, and 2000 cps with the speech reception threshold as obtained with the spondee test lists. In the Veterans Administration the relationship is applied to the initial examination for disability rating. If the pure tone speech reception relationship is within 12 db. on two successive tests, they are considered valid; otherwise, the veteran is studied for a possible functional hearing loss. The Doerfler-Stewart test, which is designed to break down the established spurious loudness level by introducing a specially designed noise over a speech signal, has proved very useful in building the case against the malingerer in the Armed Forces. This test should be routine in all cases where malingering is suspected. The psychogalvanic test is not a test for malingering but can be used to help in its discovery. This test is not really an objective hearing test which requires no active response. The psychogalvanic test is a conditioned response and is therefore not strictly an objective test. The delayed speech feedback test is probably the only test available now which might differentiate malingering from psychogenic overlay. This text was first reported by B. S. Lee (Effects of Delayed Speech Feedback, *J. Acoust. Soc. America* **22**: 824, 1950). If we assume that the case with a psychogenic overlay has a high order neural block, the delayed speech feedback should not confuse him, whereas the malingerer should be confused because he is unable to control the effects of the delayed speech on his monitoring feedback circuit. Glorig is of the opinion that tests merely add weight to the case against the malingerer and the result depends upon who is more clever, the doctor or the patient.

Hanley and Tiffany [62] present a test for simulation deafness or psychogenic deafness. The requirements for a successful test are that it be simple of administration, capable of interpretation by a reasonably intelligent layman, and productive of reliable repeatable results. The test which fits these requirements is the delayed side tone test first described by Lee. The subject is asked to read a simple passage or perform some simple oral task while he wears a pair of earphones. As he reads his voice is recorded and then with about a 0.2-second delay is fed back at a controlled intensity level to the subject's earphones. A profound change is observed in the speech of the hearing subject which he is unable to control. His enunciation is slurred, he stutters, speech is slowed, and voice quality and pitch control are lost. No one with normal hearing acuity has been able to "beat" this test, especially when whistling is included in the measures taken. As long as the person hears the tone 20 to 40 db. above his threshold, his speech will be affected.

25 E. Washington (2).

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Abstracts from Current Literature

Ear

NORMAL HEARING AND ITS RELATION TO AUDIOMETRY. J. DONALD HARRIS, Laryngoscope **64**:928 (Nov.) 1954.

Standards for audiometry are reviewed, explained, and a new laboratory hearing standard proposed.

The "zero" reading in the American audiometer is based upon surveys made upon subjects of different ages, including some older people, coming from all sections of the population. Obviously, if the testing were done with only the young with no hearing defects, the zero would be fainter, up to 10 db. at some frequencies. The British investigators Lüscher and Zwislocki confirm this.

The older method of determining the sound pressure exacted was with the use of a Type 9A coupler. It is shown that this, due to various factors, does not always give the same sound pressure within the ear canal. A better method for measuring sound pressures is by using a tube within the canal itself. This tube is connected with a microphone and the sound pressure recorded. A comparison of the two methods is shown.

The hope is expressed that an improved standard be adopted and that this be universal throughout the world.

HITSCHLER, Philadelphia.

AN EVALUATION OF CERTAIN THERAPEUTIC AGENTS AND PROCEDURES IN THE TREATMENT OF ACUTE DIFFUSE EXTERNAL OTITIS. B. H. SENTURIA, R. J. CROSS, J. E. LETT, and A. V. HARDY, Laryngoscope **64**:1001 (Dec.) 1954.

Three hundred eighty-six ears with acute diffuse external otitis were included in this study. Cultures and sensitivities were done on all. The agents tested were (1) oxytetracycline HCl, (2) polymyxin B sulfate, (3) 4-aminomethylbenzensulfonamide HCl, 5%, (4) nitrofurazone, (5) oxytetracycline HCl and polymyxin B sulfate, and (6) controls: (*a*) isotonic (0.85%) saline drops and (*b*) fatty acids in a Lanolin vehicle.

The ear canal was cleaned and the agent applied either on a wick or by drops (less severe cases) every four hours. The agents were taken in order. If there was no improvement after several days, the agent was changed to that indicated by the sensitivity test. In general the results were discouraging. No particular agent stood out as particularly beneficial. Even cases treated with the controls sometimes responded as well. It was felt too that the importance of the in vitro sensitivity tests was questionable and should therefore only serve as a guide in treatment. Of note is that one of the authors (B. H. S.) feels that the Pseudomonas is not the primary offending organism but another, which lies deeply in the dermis. The treatment therefore might better be parenteral.

HITSCHLER, Philadelphia.

BACTERIOLOGICAL STUDIES OF OTITIS EXTERNA—1951, 1952, AND 1953. ALBERT V. HARDY, MINNIE SCHREIBER, WARREN R. HOFFERT, ELIZABETH YAWN, ROLAND B. MITCHELL, and FLORENCE YOUNG, Laryngoscope **64**:1020 (Dec.) 1954.

The bacterial flora of the normal ear and the ear with external otitis was studied. The study was primarily a laboratory one. It was conducted during three summers (1951, 1952, and 1953) in Florida. Tables show the number and presence of each kind of bacteria in normal and infected ears for each year. Most outstanding was the predominance of the Pseudomonas group in the infected ears. It ran from 65%-88%. Next high was the coli-aerogenes group, then the Staphylococcus. Also prominent was the absence of mycological flora. Normal ears showed very little (1%-1.3%) Pseudomonas but a fair number of gamma-type streptococci and Staphylococcus albus.

HITSCHLER, Philadelphia.

SPEECH DISCRIMINATION IN CENTRAL AUDITORY LESIONS. THEADORE E. WALSH and ALLAN GOODMAN, Laryngoscope **65**:1 (Jan.) 1955.

The audiological findings to be expected in lesions of the eighth nerve central to the cochlea have been under some controversy. Cases here presented show that the discrimination was severely affected even when the threshold loss was small (contrary to some opinions). In only one case was there any recruitment, and this was small. There was diplacusis in several of the cases, a symptom commonly associated with cochlear lesions. Walsh and Goodman conclude that recruitment is apparently the only auditory sign which differentiates cochlear from retrocochlear lesions (cochlear lesions having recruitment).

HITSCHLER, Philadelphia.

RECENT OBSERVATIONS ON THE USE OF NASOPHARYNGEAL IRRADIATION FOR THE CONTROL OF HEARING IMPAIRMENT IN CHILDREN. JOHN E. BORDLEY, South. M. J. **47**:246 (March) 1954.

The author presents a preliminary report on a study of 5000 children. Five hundred of these were selected for intranasal treatment with anhydrous radium sulphate applicators. One-half of this group were used as controls, the applicator being used without radium. The physicians giving treatment and following the children did not know which were the real and which were the control applicators. It was noted that a marked reduction in lymphoid tissue takes place following irradiation and that severe conductive type hearing loss of fluctuating type is improved by this technique. There was no untoward effect noted from the treatment employed.

LOGAN, Rochester, Minn. [A. M. A. AM. J. DIS. CHILD.].

Pharynx

ABSENCE OF TONSILS AS A FACTOR IN THE DEVELOPMENT OF BULBAR POLIOMYELITIS. G. W. ANDERSON and J. L. RONDEAU, J. A. M. A. **155**:1123 (July 24) 1954.

Recently the proportion of cases of poliomyelitis with bulbar paralysis has supposedly increased and is greater in the older age group. One of the factors that has been suggested as significant in this localization is whether or not tonsillectomy has been performed at any time previous to the illness. Anderson and Rondeau briefly review the findings of Top and Vaugnan (1941) and four other studies, all of which indicate that the presence or absence of tonsils at the time of attack by the poliomyelitis virus appeared to be one of the factors determining the type of response to the virus invasion. The study reported here is an attempt to confirm the observations of Top and to explore some of the causative factors.

This investigation is based on epidermiological histories gathered during the 1946 outbreak in Minnesota. In all, 2669 histories were used in the study. The author found that persons with the bulbar type of poliomyelitis give a history of removal of the tonsils more frequently than do persons with other forms of poliomyelitis and that, if clinically recognizable poliomyelitis develops in a person who has had his tonsils removed, the likelihood of bulbar involvement is four times as great as in one whose tonsils are in situ. This higher proportion of cases of bulbar involvement in patients who have had tonsillectomy occurs at all ages regardless of the time that has elapsed since operation. This higher proportion in older persons is due primarily to absence of the tonsils rather than to age per se. The higher proportion of bulbar involvement in recent years may be due to the greater frequency of tonsillectomy and the shift in age distribution of poliomyelitis to the ages at which tonsils may have been removed. The lack of cases of bulbar involvement in certain areas may be due to the concentration of poliomyelitis in ages before tonsil removal.

Numerous hypotheses that have been advanced to explain the above findings are discussed. It is pointed out that the excess of bulbar involvement in persons who have had tonsillectomy may possibly be due to direct invasion along fibers of the 9th and 10th cranial nerves.

The data here presented do not suggest that a child who has had a tonsillectomy is any more or less likely to have a recognizable form of the disease if he is infected. They do, however, show that if a recognizable form of the disease occurs in a person who has had tonsillectomy, it is more likely to be of the bulbar type than if the person had not had his tonsils removed. The authors draw no inference as to the desirability of tonsil removal but do suggest the importance of suitable indication for removal before operation is undertaken.

ALPERS, Philadelphia [A. M. A. ARCH. NEUROL. & PSYCHIAT.].

TONSILLECTOMY AND ADENOIDECTOMY. JOSEPH A. JOHNSTON and THOMAS W. WATKINS, J. Pediat. **44**:127 (Feb.) 1954.

The tonsil and adenoid problem is not a simple one. Cold statistics on the value of tonsillectomy and adenoidectomy can be misleading. In this report, Johnston and Watkins take into account the normal involution of this tissue. They recognize the importance of allergy and they point out the value of chemotherapy and antibiotics. They agree that the privilege of operation may be abused but think that we may sometimes be too conservative. In selected cases, they say, removal of tonsils and adenoids may be helpful.

In their study of 598 cases, removal of tonsils and adenoids reduced a significant number of frequent respiratory infections and ear infections and cases of abdominal pain referrable to chronic throat infection. Recurrent bronchitis was improved most in children over 4 years of age. With sinus infection and with asthma, the results were equivocal. However, the authors state that it is illogical to try to desensitize the asthmatic patient with bacterial vaccines in the presence of infected tonsils in a child over 8 years whose attacks are always precipitated by infection.

In properly selected cases, removal of tonsils and adenoids may improve the appetite and nutritional states, may help to prevent recurrent vomiting, and may be indicated in cases of infectious arthritis.

The authors stress that the decision for surgery must be arrived at after sufficient observation has excluded other causes for the presenting complaint.

MACDONALD, Pittsburgh [A. M. A. AM. J. DIS. CHILD.].

THE CONTROL OF POSTOPERATIVE ADENOID BLEEDING WITH ADRENOSEM. CASPER B. OWINGS, Laryngoscope **65**:25 (Jan.) 1955.

Adrenosem (manufactured by Massengill) has apparently cut down postoperative adenoid bleeding. The incidence prior to the use of Adrenosem was approximately 10% at the Germantown Hospital. In 102 cases with Adrenosem, only 1 has bled sufficiently to be packed. No untoward side-effects have been noted. It is given 15 minutes preoperatively, I. M., 2.5 mg. for children and 5 mg. for adults. Repeated doses may be given if necessary. Its mode of action is not well understood, but is thought to increase the elastic tone of the connective material between the body cells.

ABSTRACTOR'S COMMENT: I have used this drug in a few cases. At first the results were similar to those noted above. Recently, however, more adenoid bleeding has occurred despite its use.

HITSCHLER, Philadelphia.

THE EFFECT OF TONSILLECTOMY ON THE MORBIDITY AND THE COURSE OF DIPHTHERIA. B. CARLETTI and D. MARRA, Minerva pediat. **6**:726 (Sept. 30) 1954.

Some data have been gathered in the city of Milan, an industrial community, as to the significance of a previous tonsillectomy on the incidence and the nature of diphtheria. Diphtheria among tonsillectomized children is less frequent, less severe, and more prone to involve the nose and the larynx. Adults and children under 6 years of age seem to get less protection against the disease by reason of a previous tonsillectomy than do the older children.

HIGGINS, Boston [A. M. A. AM. J. DIS. CHILD.].

Larynx

THE SURGICAL TREATMENT OF CARCINOMA OF THE CERVICAL ESOPHAGUS. GEORGE A. SISSON, New York J. Med. **55**:201 (Jan. 15) 1955.

Sisson reports from the State University College of Medicine, Head and Neck Service, at Syracuse, N. Y. The first symptom of carcinoma of the cervical esophagus is often difficulty in swallowing, with huskiness. Paralysis of one cord may be present. Later there are dysphagia, odynophagia, regurgitation with or without blood-tinged saliva, and a hard node in the neck. Endoscopy and laminagraphy usually help to establish the diagnosis. The condition is primary in the esophagus or secondary to cancer of the larynx, thyroid, or pharynx. Before doing surgery, one must consider the patient's age, previous therapy, and general body physique and health. A poor surgical risk is estimated upon the probable ability of the patient to undergo

three or four hours of surgery. Surgery of the esophagus goes back to (possibly beyond) the work of Czerny (1877). He reported extirpation with a 15-month survival. Mikulicz (1884) set the pace for many other surgeons. In this country, plastic surgeons have been much interested in trying to establish a new substitute esophagus. Early diagnosis and skillful surgery may bring five-year "cures." Sixteen of the 17 cases reported were men. Five were primary in the cervical esophagus, 12 secondary. Epidermoid cancer was the common type. Radical surgery calls for choice of anesthesia, blood replacement, and infection control; preoperative care is the *sine qua non*. Many patients are anemic, dehydrated, septic, and poorly nourished. If a feeding tube cannot be passed, a gastrostomy is in order. Thiopental (Pentothal) sodium plus endotracheal ether is preferred for narcosis. Five varying surgical procedures were used, each chosen for the case at hand. The throat specialist must be on the alert for early diagnosis of cancer of the esophagus.

I. W. VOORHEES, New York.

CONGENITAL STRIDOR AND MALFORMATIONS OF THE TRACHEA. W. HIRSCH, M. LOEWENTHAL, and S. SWIRSKY, Ann. pædiat. **182**:1 (Jan.) 1954.

Three cases of obstructive laryngotracheal conditions (inspirational and expirational congenital stridor) are presented in children 4 months, 9 months, and 2.9 years old. In the first two, the postmortem examination showed a defect in the formation of the trachea above the bifurcation. In the third, which developed normally later on, the same congenital malformation of the cartilaginous rings of the trachea could be assumed on the basis of x-rays and direct tracheoscopy. The relation between the anatomical and the clinical signs is discussed.

FROM THE AUTHORS' SUMMARY [A. M. A. AM. J. DIS. CHILD.].

BRONCHOSCOPY IN BRONCHIAL GLAND PERFORATION. EMILIO ALEMAN, J. M. ROUCO, and E. RIVERO, Arch. med. inf. **23**:222 (July, Aug., and Sept.) 1954.

We have made a correlated study of the roentgenological, bronchographic, and bronchoscopic data in 15 cases showing perforation of a caseous lymph node into the bronchial lumen as a complication of childhood type tuberculosis found among 60 cases of pulmonary consolidation in children from 0 to 5 years of age.

There were abnormalities in 12 of the 15 cases, developed as consequence of the bronchial wall alterations determined by the fistula itself. The pathological aspects were distributed as follows:

Complete stenosis of a bronchus—5 cases

Partial stenosis of a bronchus—2 cases

Widespread bronchial dilatations—1 case

Slight bronchiectasis—2 cases

Bronchiectasis plus agglutination—2 cases

FROM THE AUTHORS' SUMMARY [A. M. A. AM. J. DIS. CHILD.].

Nose

THE MANAGEMENT OF EPISTAXIS. WILLIAM H. EVANS, Laryngoscope **64**:911 (Nov.) 1954.

This is a broad review of the problem of epistaxis. It includes causes of the condition and the sites most encountered. Many substances used for the control of bleeding are mentioned. Management is discussed in detail, for both children and adults. The use of oxidized cellulose in large amounts is cautioned against. In one case a septal perforation resulted. In telangiectasis a rubber balloon is preferable to packing. X-ray treatment and electrocoagulation of the local area may be necessary.

Cortisone or corticotropin (ACTH) has been used successfully in purpura, chronic hypoplastic anemia, and pseudohemophilia.

Minor surgical procedures are sometimes resorted to. They include the elevation of the nasal mucosa and submucous resection. Occasionally one must ligate one or more of the major arteries. The techniques are described.

HITSCHLER, Philadelphia.

DISCUSSION ON THE TREATMENT OF NASAL POLYPI. S. W. S. HARGROVE, Proc. Roy. Soc. Med. **47**:1015 (Dec.) 1954.

The occasion was a joint meeting of the Laryngology and Otology Sections at Scarborough, England, June 11, 1954, under Chairman C. P. Wilson, C.V.O., F.R.C.S. (President of the Section on Laryngology). Mr. Hargrove reviewed the history of nasal polypi from Galen and Hippocrates through Morgagni and Valsalva, on to Sir Morrell Mackenzie (1884). Also the names of Hajek, Mosher, Ballenger, and Sluder are mentioned. He said that polyposis is "a generalized disease," with a causal allergy in the background. The ethmoidal labyrinth is the site of origin in most instances, with the polypi arising in the sinuses, turbinates, and septum on occasion. The classification of Skillern (1923) is set down, and the later one of Eggston and Wolff (1947) follows. The latter recognizes hypertrophic or polypoidal sinusitis; the sclerosing, fibrotic, or arteriofibrotic (atrophic) type; the papillary type; follicular type; glandular or adenomatous sinusitis. Hargrove, after reviewing intranasal and other methods of treatment, emphasizes the merit of using the external route of Ogston-Luc or, preferably, the Norman Patterson procedure, which he employed in 71 cases. "The object of the operation is to remove all polypus-bearing areas," which calls for elimination of the ethmoid labyrinth and the middle and superior turbinates. Results were excellent, with return of smell and taste (after eight months) and improvement in general health. The paper was discussed by several, among them Mr. V. E. Negus, who is so highly thought of in the U. S. He thinks that intranasal removal is adequate if combined with medical treatment such as calcium gluconate and dilute nitrohydrochloric acid. "The approach from above . . . seemed to be a most inconvenient one, and . . . difficulties were being made which could be avoided by the more usual approach. . . . It seemed unusual and unnecessary to perform an external operation before the maxillary sinus had been adequately dealt with. . . . Approach to the ethmoid cells by the infra-orbital incision seemed an inconvenient method" because of the necessity of sparing the lachrymal duct and sac.

ABSTRACTOR'S COMMENT: Most of the speakers seemed to have in mind a pansinusitis with involvement of the frontal, ethmoid, and antrum. The sphenoid was not considered by most of the discussers. But should it not be, in judging whether all four are involved? In doing a frontal Killian, many American surgeons carry the incision down across the nasal bones and make ethmoid obliteration a part of the whole procedure, which, I think, was the original method of Killian. So much can be accomplished by the intranasal electrocautery and destructive acid agents, such as chromic and bichloracetic acids, that an external radial operation on the ethmoid is likely to be performed only where necrosis of bone is probable when judged by preoperative x-ray studies. Removal of nasal polypi is quite often the job set for a beginner in rhinology. It is a trying test of skill where the snare is used, and also because there is always another polyp to fill in the space where one has been removed! Association of polypi with allergic states was not generally accepted here until some 25 years ago. It marked a decided advance in rhinologic thinking.

I. W. VOORHEES, New York.

Miscellaneous

ARTERIOVENOUS ANEURYSM OF THE INTERNAL CAROTID ARTERY AND CAVERNOUS SINUS, TREATED BY LIGATION OF EXTERNAL AND INTERNAL CAROTID ARTERIES. JACKSON A. SEWARD, Laryngoscope **65**:18 (Jan.) 1955.

The symptoms of arteriovenous aneurysms of the internal carotid artery and cavernous sinus are exophthalmos with pulsation and bruit which can be heard in the temporal region over the mastoid. Compression of the common carotid controls the latter. Treatment consisted of ligating separately both the internal and external carotid arteries. During the operation the flow could be stopped in either or both and its effect noted. No marked changes occurred.

HITSCHLER, Philadelphia.

MANAGEMENT OF THE CHRONIC HEADACHE SYNDROME IN AN OUTPATIENT CLINIC. M. J. TISSENBAUM, A. E. KOBLENTZ, and A. P. FRIEDMAN, New York J. Med. **55**:521 (Feb. 15) 1955.

All three authors work in the Veterans Administration Regional Office in Brooklyn. They say that headache is a "challenge" to every physician, no matter what his specialty. Here we have a study of 430 veterans (with a few females also) from World War II with an average

duration of headache of six years. The headaches were classified as follows: psychogenic headaches, post-traumatic encephalopathy, migraine, and headaches associated with other organic conditions. Tension forms were the most frequent (47%), with neck and upper back involvement. This type is usually bilateral, occipital, or frontal, with anxiety symptoms, even nausea and vomiting. Taking a history of the head injury is highly important, no matter how insignificant the trauma; there are anxiety, restlessness, fatigue, fainting, loss of memory, "blackouts," and poor concentration. The important fact is brought out that even a slight blow on the head may produce all of these symptoms. As for migraine, this diagnosis is too often made superficially. Actually, there are throbbing, unilateral headaches, temporary visual disorders (such as scotomas), nausea and vomiting, a family history of migraine, and personality features, such as perfectionism, rigidity, and compulsive efficiency. Other symptoms are paresthesias, sweating, and speech disorders. Ergotamine derivatives are fairly specific in these patients. Hypertension was relatively absent (two observations only). Other organic conditions were Parkinson's syndrome, lateral sclerosis, and postmeningitic states. Treatment methods derive chiefly from an accurate diagnosis. All patients have, of course, been treated by measures which were not uniformly successful because the cause or causes were not well determined. In general, the outline is that offered by pharmacy, psychotherapy, and physiotherapy. One should not offer drugs which may be habit-forming, such as morphine, Demerol, etc. Ergot derivatives have had much notice in the literature. In general, we must sharply differentiate between organic and nonorganic causes, since the outcome may be fatal in one case and reversible in another. The patient wants to know "how long" he must endure the devilish existence, but must be made to understand that no physician dares to prophesy. Any relief is, of course, welcome, but changes in the entire plan of management must be made according to the conditions met.

I. W. VOORHEES, New York.

DYSPHAGIA OF EXTRAESOPHAGEAL ORIGIN. M. BROMBART, J. SCHUERMANS, and M. SEGERS, Acta oto-rhino-laryng. belg. **7**:231, 1953.

The authors present a list of mediastinal diseases which are causes of extraesophageal dysphagias. They have been able to demonstrate these entities by clinical and radiological examination. They find that high, or pharyngoesophageal, dysphagia may be produced by pharyngovertebral adhesions in deforming cervical spondylosis or by compression and displacement, as in goiter, in cancer of the thyroid, and in retropharyngeal localization of malignant lymphogranulomatosis. Dysphagia may be associated with pleuropulmonary fibrosis, acquired esophageal fistula, Pott's disease, metastatic adenopathy and primary mediastinal tumors, acquired cardioaortic diseases, mitral valve diseases, aortitis, and aneurysm and distortion of the thoracic aorta.

STEINBERG, Philadelphia.

Directory of Otolaryngological Societies *

FOREIGN AND INTERNATIONAL

Canadian Otolaryngological Society
(Société Canadienne d'Otolaryngologie)

President: Dr. G. Edward Tremble, 1390 Sherbrooke St. West, Montreal.
Secretary: Dr. G. Arnold Henry, 170 St. George St., Toronto.
Place: Bigwin Inn, Lake of Bays, Muskoka, Ont.

International Bronchoesophagological Society

President: Dr. Antonio da Costa Quinta, Lisbon, Portugal.
Secretary: Dr. Chevalier L. Jackson, 3401 N. Broad St., Philadelphia 40.
Meeting: Fourth International Congress of Bronchoesophagology.
Place: Buenos Aires, Argentina. Time: Oct. 28-29, 1955.
President of Congress: Dr. Antonio Carrascosa.

International Congress of Audiology

Place: Leyden, Netherlands.
General Secretary: Dr. H. C. Huizing, 182 Oostersingel, Groningen, Holland.

International Course in Paedo-Audiology

Place: Groningen, Netherlands.
General secretary: Dr. H. C. Huizing, 182 Oostersingel, Groningen, Holland.

Pan-American Association of Oto-Rhino-Laryngology and Broncho-Esophagology

President: Dr. Juan Manuel Tato, Azcuenaga 235, Buenos Aires, Argentina.
Secretary: Dr. Chevalier L. Jackson, 3401 N. Broad St., Philadelphia 40.
Meeting: Fifth Pan-American Congress of Oto-Rhino-Laryngology and Broncho-Esophagology.
Place: San Juan, Puerto Rico. Time: April 8-12, 1956.
President of Congress: Dr. Juan H. Font, Medical Arts Building, San Juan.

Sixth International Congress of Otolaryngology.

President: Dr. Arthur W. Proetz, 3720 Washington Blvd., St. Louis.
General Secretary: Dr. Paul H. Holinger, 700 N. Michigan Ave., Chicago 11.
Place: Hotel Statler, Washington, D. C. Time: May 5-10, 1957.

NATIONAL

American Medical Association, Scientific Assembly, Section on Laryngology, Otology and Rhinology

Chairman: Dr. John R. Lindsay, Chicago.
Secretary: Dr. Hugh A. Kuhn, 112 Rimbach St., Hammond, Ind.

American Academy of Ophthalmology and Otolaryngology

President: Dr. Algernon B. Reese, 73 E. 71st St., New York 21.
Executive Secretary-Treasurer: Dr. William L. Benedict, 100-1st Ave., Bldg., Rochester, Minn.
Place: Palmer House, Chicago. Time: Oct. 9-15, 1955.

* Secretaries of societies are requested to furnish the information necessary to keep this list up to date.

AMERICAN BOARD OF OTOLARYNGOLOGY

President: Dr. Frederick T. Hill, Professional Building, Waterville, Maine.

Secretary-Treasurer: Dr. Dean M. Lierle, University Hospitals, Iowa City.

Place: Sheraton-Mount Royal Hotel, Montreal, Canada. Time: May 6-11, 1956.

AMERICAN BRONCHO-ESOPHAGOLOGICAL ASSOCIATION

President: Dr. Daniel S. Cunning, 115 E. 65th St., New York 21.

Secretary: Dr. F. Johnson Putney, 1719 Rittenhouse Sq., Philadelphia 3.

Place: Sheraton-Mount Royal Hotel, Montreal, Canada. Time: May 15-16, 1956 (afternoons only).

AMERICAN LARYNGOLOGICAL ASSOCIATION

President: Dr. Bernard J. McMahon, 8230 Forsyth Blvd., Clayton 24, Mo.

Secretary: Dr. Harry P. Schenck, 326 S. 19th St., Philadelphia 3.

Place: Seigniory Club, Montreal, Canada. Time: May 13-14, 1956.

AMERICAN LARYNGOLOGICAL, RHINOLOGICAL AND OTOLOGICAL SOCIETY, INC.

President: Dr. Dean M. Lierle, Iowa City.

Secretary: Dr. C. Stewart Nash, 708 Medical Arts Bldg., Rochester 7, N. Y.

Place: Sheraton-Mount Royal Hotel, Montreal, Canada. Time: May 15-17, 1956 (mornings only).

SECTIONS:

Eastern.—Chairman: Dr. John A. Murtagh, Hanover, N. H.

Place: The Statler Hotel, Boston. Time: Jan. 13, 1956.

Southern.—Chairman: Dr. J. M. Robison, Houston, Texas.

Place: The Shamrock, Houston, Texas. Time: Jan. 27-28, 1956.

Middle.—Chairman: Dr. William H. Craddock, Cincinnati.

Place: The Netherlands Plaza, Cincinnati. Time: Jan. 16, 1956.

Western.—Chairman: Dr. David D. De Weese, Portland, Ore.

Place: County Medical Society Building, San Francisco. Time: Jan. 21, 1956.

AMERICAN OTOLOGICAL SOCIETY, INC.

President: Dr. William J. McNally, 1509 Sherbrooke St. West, Montreal 25, Canada.

Secretary-Treasurer: Dr. Lawrence R. Boies, 90 S. Ninth St., Minneapolis 2.

Place: Seigniory Club, Montreal, Canada. Time: May 11-12, 1956.

AMERICAN OTORHINOLOGIC SOCIETY FOR THE ADVANCEMENT OF PLASTIC AND RECONSTRUCTIVE SURGERY, INC.

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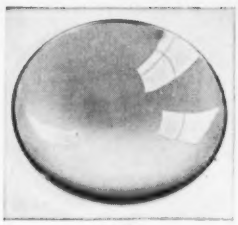
AMERICAN SOCIETY OF OPHTHALMOLOGIC AND OTOLARYNGOLOGIC ALLERGY

President: Dr. F. Lambert McGannon, 14595 Madison Ave., Lakewood, Ohio.

Secretary-Treasurer: Dr. Michael H. Barone, 468 Delaware Ave., Buffalo 2.

Place: Palmer House, Chicago. Time: 1955.



N-1006

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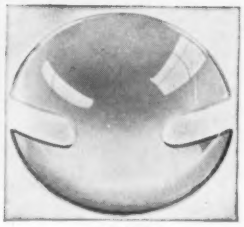

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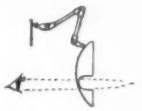

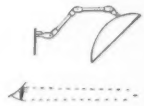

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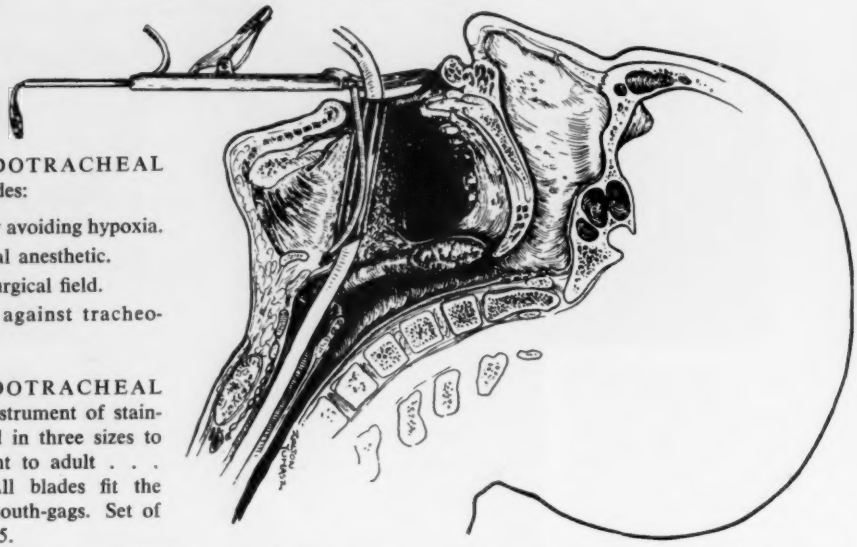

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*Barton, R. T.: Instrument for endotracheal anesthesia during oro-pharyngeal surgery. J. A. M. A. 153:1017 (Nov. 14) 1953.

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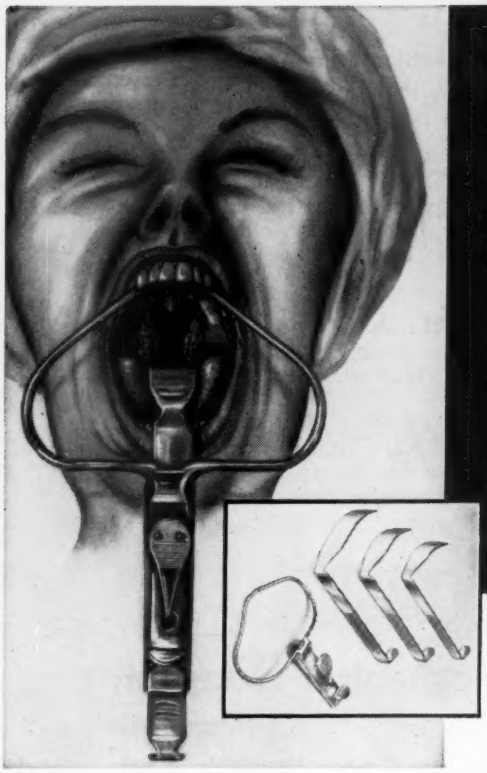

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* See page 662 AMA Archives of Otolaryngology, June 1955. For other instruments designed by Dr. Benito B. Rish refer to:
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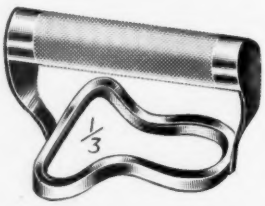

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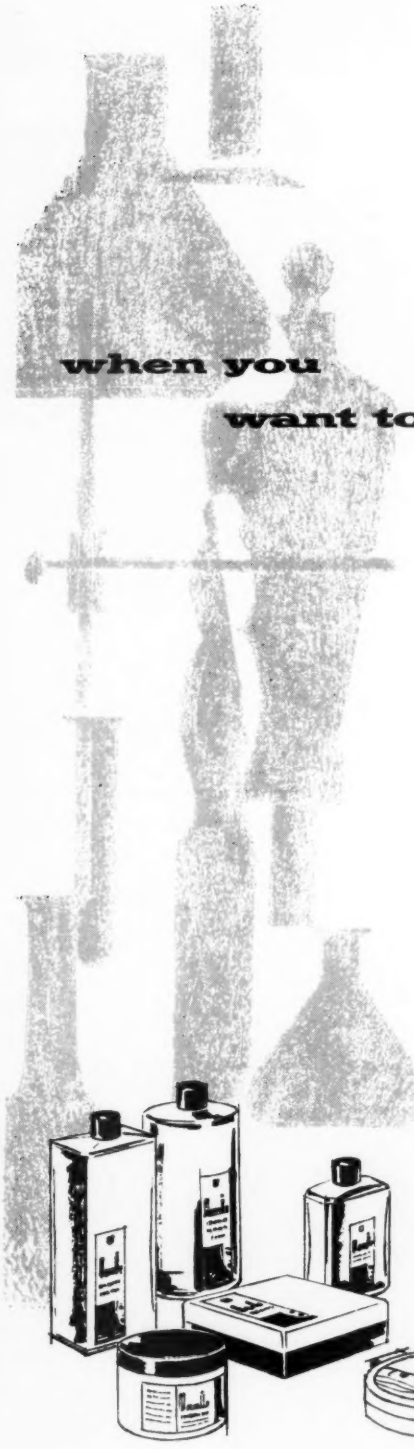

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